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Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

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AUSTRALIAN WASTE DISPOSAL PROPOSAL COULD LIMIT NUCLEAR PROLIFERATION

Scientist Cited on Process

Canberra THE AUSTRALIAN in English 30 Nov 83 p 7

[Article by Jane Ford]

[Excerpts] Shrouded beneath the emotive slogans, anti-nuclear demonstrations and political infighting over uranium are two very basic questions.

In Australia, Professor Ted Ringwood, director of the Australian National University's Research School of Earth Sciences, believes he has the answer--both to safe disposal and nuclear proliferation--with his own specially engineered synthetic waste form, Synroc.

This actually incorporates the high-level nuclear wastes into its crystalline structure, immobilising them for millions of years.

The original Synroc, which consists of three naturally occurring minerals--zirconlite, perovskite and hollandite--was developed to handle reprocessed high-level wastes but Professor Ringwood has now developed a new form, Synroc F.

This can incorporate spent fuel which has not been reprocessed to remove plutonium and, according to Professor Ringwood, is extremely stable and leach-resistant and a major step in the fight against nuclear proliferation.

This would mean the untreated waste would be incorporated directly into Synroc which would be tightly sealed in stainless steel canisters and then buried up to 4km underground in drill holes in areas of impermeable rock, well below the regions normally affected by groundwater.

Professor Ringwood points out that Synroc, unlike borosilicate glass, is highly resistant to leaching by groundwater and very resistant to high temperatures and pressures.

He estimates that one drill hole, 1m in diameter, could hold all the nuclear waste produced in Britain over a four-year period.

The holes would be sealed and it would be virtually impossible to retrieve the waste, so eliminating the possibility of the plutonium ever being extracted and used for nuclear weapons.

Professor Ringwood admits it is an expensive way of handling nuclear waste, as the relatively valuable plutonium would be lost forever, but thinks it offers the best answer both to disposal and proliferation questions.

"A moratorium on reprocessing for two or even three decades would not seriously deplete world uranium reserves, but might provide a breathing space in which to develop technologies or institutional structures with a greater potential to inhibit the diversion of plutonium into the manufacture of weapons," he says.

He believes large quantities of spent fuel stored in one large, relatively shallow, underground repository will provide a "lethal temptation" to future generations.

"The fuel could readily be rediscovered and excavated, particularly after a few hundred years when the fission products had decayed. They could then be reprocessed to recover plutonium with the additional incentive of very large tonnages of copper or other valuable metals in the canisters."

He argues that with Synroc, Australia could set up its own nuclear industry including reprocessing, enrichment, fuel fabrication and waste disposal facilities, handling wastes from our own uranium exports and burying them deep in the Australian outback.

He believes this would be a significant step by Australia towards cutting back the chances of nuclear proliferation as well as providing a major economic boost.

"The Synroc strategy of waste disposal has been specifically designed to meet the 'public acceptability' criteria. The waste form is made of minerals which are known to have survived in nature for many millions of years, despite very high radiation doses and extreme geochemical conditions," he says.

But some are not so sure about Synroc. They admit that potentially it offers a far superior waste disposal method to borosilicate glass but point out that it has not been tested with real radioactive waste and, as such, is an untried technology.

A commercial sized demonstration plant to prove the feasibility of Synroc is under construction at the Atomic Energy Commission's Lucas Heights site near Sydney but even this will only use simulated nuclear waste, although one very small-scale test with radioactive waste is planned.

Detractors say even if it was proved technically sound, it would take many years to scale up to a commercial stage and in the meantime it is likely most countries will have opted for glass storage in shallow-mined

repositories. Synroc could not provide an answer until the 1990s at the earliest by which time most countries would have had to solve their waste problems.

The US has already tested one form of Synroc, Synroc D, for military wastes and rejected it in favor of glass. In other countries acceptance has not been rapid, possibly because of the enormous investment already put into glass technology.

But interest is growing and Britain, Germany and Japan are investigating Synroc, on a small scale, and Professor Ringwood believes this is good start towards more widespread adoption of the technology.

He believes Australia should be the first to take up the new technology, develop its own nuclear industry and reap the commercial benefits.

"We could make an important contribution to improving the nuclear fuel cycle's safety by producing a superior high-level nuclear waste form, by reducing the potential problems associated with proliferation of plutonium. And by further delaying the introduction of the plutonium economy. In addition, we would create new high-technology industries in this country which would provide employment for tens of thousands of people."

These arguments are likely to fall on deaf ears in a government which is already fighting a tough battle on the question of the mining and export or uranium let alone a fully fledged nuclear industry. [as published]

Report Cites Indonesian Nuclear Capability

Canberra THE AUSTRALIAN in English 30 Nov 83 p 9

[Article by Jane Ford]

[Text] Australia should become the base of a multi-billion dollar nuclear fuel industry, servicing the entire western Pacific region as well as other nuclear nations, according to a controversial report circulated to all MPs.

The report recommends establishing a $4000 million nuclear fuel cycle centre, owned by a consortium of western Pacific nations, and housing enrichment, reprocessing, fabrication and waste-disposal facilities. A fuel fabrication plant would cost a further $250 million.

The report argues this would greatly reduce the risk of nuclear proliferation in the region as well as ensure long-term uranium export contracts for Australia. It would mean the development of a new, high-technology industry with the capacity to create thousands of jobs.

The proposal has been submitted by an Australian expert on nuclear waste disposal, Professor Ted Ringwood (the developer of the new synthetic

waste form, Synroc), and circulated at the request of the Minister for Trade, Mr Bowen.

Professor Ringwood estimates the centre would be able to generate more than $1500 million a year.

He argues such a centre would allow Australia to keep a tight rein on nuclear development in the region, ensuring strict nuclear safeguards, deterring nuclear proliferation, and exerting a strong influence on nuclear policy.

He says Indonesia already is building a big nuclear research centre, which will include a reactor using enriched uranium, a plant to produce reactor fuel elements and a waste management facility.

Immobilising

This should be completed by 1989, and is probably only the first stage. The extent of the facilities suggests Indonesia plans to develop advanced nuclear technology.

"It should be recognised that if Indonesia chose to withdraw from the Non-Proliferation Treaty in the 1990s, she would then possess the capacity to produce nuclear weapons within a relatively short interval, possibly less than four years," he said.

Professor Ringwood proposes the high-level waste left after reprocessing could be incorporated in Synroc--a stable synthetic rock capable of immobilising high-level nuclear waste for tens of thousands of years.

A commercial-sized Synroc demonstration plant is being built at the Atomic Energy Commission's Lucas Heights facility near Sydney.

Professor Ringwood suggested that canisters of Synroc could either be returned to their country of origin or buried in deep-drilled holes in Australia.

"This may strike emotive chords, but should nevertheless be considered on its merits and on the basis of technical evidence relating to safety. Australia possesses considerable natural advantages over many nuclear countries, such as Japan, for the disposal of high-level waste."

He stressed Australia must face reality. Lack of Australian uranium would not affect the development of nuclear industries in other countries.

"A refusal to supply Australian uranium to the world market would be an empty gesture. It would not have any influence whatsoever on the commitments of many foreign countries to nuclear power; its only effect would be to increase the pressures for ultimate development of fast-breeder reactors and the plutonium economy."

CSO: 5100/4352

NEW WORK ORGANIZATION METHODS TO IMPROVE NE CONSTRUCTION

Prague HOSPODARSKE NOVINY in Czech 28 Oct 83 p 3

[Article by Dr Miroslav Cihlar and Engineer Zdenek Chalus, CSc, of the Research Institute of Structural Engineering in Prague, Engineer Milos Drahny, CSc, of the Czechoslovak Atomic Energy Commission, and Engineer Stanislav Havelka, CSc, of the Nuclear Research Institute in Rez: "From Comprehensive Efficiency Brigades to Matrix Management of Research and Development"]

[Text] The problems we frequently encounter in solving the construction of a nuclear power complex we solve within the limits of our own competence, on a small scale. In the course of this we find repeatedly that a systems solution would be far more efficient. It seems that if greater social efficiency is to be achieved, the solution must be perfected of the question of interactions between the engineering design of a part on the one hand, and the environment, the higher system, on the other.

Questions of relationship appear to be the most serious problem in such interaction. Therefore we believe that it is necessary to call attention to the possibilities that matrix management offers, especially from the viewpoint of speeding up construction, greater adaptability, and the removal of departmental barriers. The method was suggested by the comprehensive efficiency brigades, but nothing more was done beyond these suggestions.

Comprehensive Efficiency Brigade

At the nuclear power plant in Jaslovske Bohunice, the oldest construction site in our nuclear power program, a comprehensive efficiency brigade of nuclear power plant construction was formed in May. It included technicians of Hydrostav [Hydraulic Engineering Construction] Bratislava, Industrial Structures (Prumyslove stavby) Brno, Hydraulic Engineering Structures (Vodni stavby) Prague, also designers of Energoprojekt [State Institute for Designing Power Plants] and staff members of the Research Institute of Structural Engineering (Vyzkumny ustav pozemnich staveb) in Prague. The subject of discussion was the solution of specific engineering problems that were common to all construction projects under the nuclear power program in Czechoslovakia. Specific resolutions were adopted for each item on the agenda, and also tasks with target dates, as required for the work of a comprehensive efficiency brigade.

Why are we reporting the formation of a new comprehensive efficiency brigade? Primarily to inform that groups comprising workers of different organizations

and departments who are solving problems that intersect their spheres of authority are, as all the experience to date indicates, a prerequisite for speeding up the application of new equipment and technologies, and of new technical and economic approaches, in such a complicated system as a nuclear power complex. And also to warn that the establishment of conditions for the formation, functioning and orientation of such an initiative is complicated and requires support.

The traditional comprehensive efficiency brigade certainly is a suitable form. It usually concentrates on a narrow circle of problems, in order to quickly introduce into production specific and often partial matters. But organizationally it is able to master only innovation of a lower order.

But what about tasks that require a long lead time to develop equipment, materials, etc.? The point here is not merely the solution of engineering problems, but primarily the mastering of the economic impact of partial effects upon the larger unit. Such a unit in our case is the nuclear power complex. Furthermore, it is causing important structural changes in the entire economy. Since it is of a multisectoral nature, it can be managed efficiently only at a level above the ministries, from the viewpoint of society as a whole, in close contact with the management of international cooperation in production and in research and development.

The functioning of a nuclear power complex is characterized by long time constants. For example, the process of building, operating and closing down a nuclear power complex takes about 50 years. The management of this process cannot be based on the momentary situation. Nor can it be reduced merely to drafting a five-year plan, with subsequent day-to-day management that will solve also serious problems as they surface and demand emergency solutions.

There are two approaches to stimulating the solution of research and development tasks: From below there is the initiative of individuals, groups or organizations, motivated primarily by their own interests. Typical of this approach is the work of the comprehensive efficiency brigade, established the most often as an intersecting structure in the preproduction phase. And from above there is the need to meet entire society's requirements, as formulated in the state target programs.

A serious shortcoming of the present methods of managing research and development is that the two approaches do not have a uniform targeted behavior. Present practice still lacks suitable methods, rules of the game, for shaping substantively the management and control of its activity. A mutual interconnection is lacking among technical, economic, and basic research. Cooperation among these areas is essential to the existence of intersectoral programs. Also the managing relationship between the research-coordinating centers and the institutes subordinate to ministries is not very effective at present. One of the reasons, for example, is the fact that the methods of managing research and development do not yet allow sufficient substantive control of how the economic contracts in research and development are being fulfilled.

The significance of a nuclear power complex warrants that it become the subject of systematic and comprehensive research. The point after all is how we build

nuclear power plants, fuel stores, waste deposits and other facilities, at what cost, with how many workers, at what consumption of materials (see the commentary on cement in issue No 32 of HOSPODARSKE NOVINY). And especially whether we are building them on schedule and in the required quality. Here is the bottom line of research and development. Only the economic and technical parameters of a specific, fully functioning power plant can tell us what its level is.

Research and Development Support

The results of the solved research tasks must be specifically targeted, adapted to the users' needs, and must also be a part of a larger entity, of the target program. The aspect of adapting to the users' needs must start out from the real possibilities of every potential user's inputs and outputs. This requires a direct and effective link between the researcher who is solving the task and the user, and not only during the realization of the results, which is primarily the user's concern, but also when the drafting problem is formulated and throughout the entire course of the work on it. Furthermore, when the drafting problem has been completed, the sponsor and the researcher must jointly determine the mode of realization.

For research does not realize the results of its own work. Only the user who manages the process into which the research results enter as background material for decision-making can apply the research results to a real object and its operation. As a rule, research work cannot be completed within the time in which the given management process takes place. It must begin with a lead time, before the actual decisions are made. Research and its sponsor must be able to foresee what documents will be needed and when, or what decisions can be made on the basis of the research results; in other words, what problems are or will be timely, and when.

The aspect of harmony between the work of the scientists who solve the research tasks and the larger entity must start out from the real possibilities of the inputs, available experience, and outputs of the appropriate state target programs. But this requires that the tasks in question be coordinated and directed. There unquestionably is integration in such an extensive system as a nuclear power complex, but it means a curtailment of the research tasks' "degrees of freedom." As the degree of integration increases, there are growing requirements regarding the management of integration. Ability to manage the integrated whole is a necessary condition for the efficiency of integration. If management is not mastered, the coordination of partial tasks becomes a bureaucratic ballast, and in their sum the attained partial returns will be far below the expected return for the national economy.

Accelerated integration appears necessary of the following programs in particular:

--State target program 01, "Development of the Nuclear Power Complex." It should cap all physical realization in conjunction with the development and operation of the Czechoslovak nuclear power complex. At present it is not elaborated sufficiently to become a mandatory document approved by the government.

--The program of Czechoslovak-Soviet cooperation in developing nuclear power generation in Czechoslovakia through 1990. It is an instrument of, and simultaneously an essential condition for, ensuring the development and operation of the Czechoslovak nuclear power complex.

State research and development program A 01, "Development of the Nuclear Power Complex as a Research and Development Instrument for Ensuring Its Development and Operation."

Even the best prepared program and planned task must respond continuously to changes in the external conditions (these occur always at the realizers and in the related tasks, especially under international cooperation), and also to unforeseen developments in the course of actual solution. The substantive content must be continuously updated, the dates must be specified more accurately, and the corresponding changes must be made in the plan. And especially the partial results must be utilized quickly.

The point, then, is that procedural relations among the individual participants in the solution must be sufficiently flexible. Such flexibility is possible, for example, at the level of the comprehensive efficiency brigade. But it is more difficult to attain at the higher levels of management, in the course of formulating the target programs. Primarily because an entire generation of technicians and economists have been trained in narrowly specialized fields. The synthesized approach today is more of an exception.

Thus a method must be found that directly compels synthesized thinking, so that the partial research and development results for realization will be optimal not only as individual elements of the system, but also from the viewpoint of the system itself. The intensity with which such methods are being sought is typical of all technically developed countries. Interesting to us are primarily the experiments that are being conducted in the USSR and the GDR.

Construction of the Nuclear Power Complex

We already know today, with sufficient accuracy for the needs of research and development, what most of the nuclear program will look like by the year 2000. It will involve established capacity series of standard design, for the generating capacities as well as their supply base. But construction is, and especially will be, taking place not only in Czechoslovakia but in other CEMA countries as well, so that there is and will be extensive practical experience. The strategy of nuclear power generation, moreover, is a concern of the entire world. We may expect to gain experience also from regions and countries that are ahead of us in this field.

Therefore we should concentrate not only on evaluating our own experience with the construction of the nuclear power complex, but also and primarily on the rapid transfer of the advanced procedures that have been tested and introduced abroad. In the construction of complicated facilities for nuclear power it is customary worldwide that the state or society with the most experience and the greatest potential in nuclear research manages construction, to varying extents, also in other countries.

From the viewpoint of research for capital construction, the purpose of which at present must be primarily the prevention of slippages and cost overruns, a distinction must be made between the following:

--Structures and equipment designed by the Soviet partner, down to the level of the construction plans; and

--Structures and equipment designed by the Czechoslovak partner, in accordance with the level of the planning and design documentation prepared in our country.

Integration of existing programs must be subordinated to these two facts. In the first case the results of research must not only be guided in terms of their content, but primarily they must be applied by the Soviet designer within a strictly defined period of time, before the elaboration of the plans.

The knowledge and experience of each country are a valuable contribution to the joint nuclear program of all CEMA countries. For example, the Soviet experience with the construction of nuclear power plants that have VVER-1000 [1000 MW water-cooled and water-moderated] reactors is valuable information. In this context it is reported that construction work accounts for 75 percent of the combined total construction and installation cost; and the installation of the mechanical and electrotechnical equipment during the process of capital construction, for 25 percent. Which means that construction work has a considerable impact on keeping the project on schedule and within the budget.

Into the program for the construction of the nuclear power program, therefore, it is necessary to integrate not only the technical questions--the introduction of new equipment, materials, construction and installation technologies--but also the questions of preparing the construction and installation work, the questions pertaining to the ability to "manage" all the activities associated with the realization of such a demanding project.

Matrix Management

Experience indicates that our national economy will be unable to develop successfully until it is able to implant the most economically basic innovations of an intersecting, intersectoral nature. Such implantations involve a series of reconstruction and investment projects that often represent revolutionary innovations in the individual sectors.

If we are to prevent the intolerable squandering of resources, these partial innovations must be coordinated in terms of their content and time. This requirement is in conflict with the current practice of management and planning which, through the system of departments and sectors, is able to efficiently ensure the development of individual branches, but it is less suitable for ensuring development through the fulfillment of the target programs. But it would be naive to imagine that the mentioned difficulties can be overcome simply by replacing the present organization of management based on the principle of target programs. Not to mention the high costs of such a reorganization, it would be unable to produce any improvement, for two reasons. First, because

comprehensive management of innovation cannot be introduced at the cost of sacrificing efficient management of the sectors' development. And secondly, because one of the basic characteristics of the set of innovation objectives is specifically its variability, which makes it impossible for the supreme organizational structure to evolve in time.

As a way out from this situation, the theory of management offers so-called matrix structures of management. Their practical application at the macroeconomic level has been the introduction of state target programs that are intended to ensure, at the level of the national economic plan, horizontal coordination of the most important intersecting programs that shape the qualitative development of the national economy. Up to now, regrettably, they have been for the most part only supplementary parts of the state plan, and input-output tables have remained the basic planning method. It will obviously be expedient to perfect the methods of balancing so that the state target programs will become full-fledged parts of the state plan, and the individual ministries will not be able to fulfill their plans without fulfilling also their contributions to the appropriate state target programs.

The replacement of the former FMTIR [Federal Ministry of Technological and Investment Development] with the State Commission for Research, Development and Investment, under a deputy premier of the federal government, provides an opprotunity for investigating the feasibility of applying matrix structures to the management of research and development. It appears expedient to use specifically the target programs, rather than the development of the departments, as the basic ordering principle for the new structure. The supervisory role of the managing work stations for research and development also should be adapted to the new structure. They should prepare forecasts, concepts, analyses and evaluations for forecasting, planning and controlling the programs' fulfillment. Furthermore, the system of managing work stations should provide methodological guidance for the individual partial target programs at a lower level.

The fact remains that at present the center is not making much use of the system of managing work stations. A comprehensive program, as well as systematic management, a structure and economic instruments are lacking for the efficient utilization of this system. These facts must be borne in mind also when formulating the methods of managing research and development. From the principle of matrix structures at the macroeconomic level is derived also the principle of lower-level intersecting target programs. Which means also the formation of comprehensive teams from the various ministries for the solution of these target programs, in the same way as this is now being done at the lower level in the form of comprehensive efficiency brigades.

In view of its size and intersectoral nature, the nuclear power complex is eminently suitable for matrix management of research and development. But it is not enough to form such matrix structures only at the lower levels.

1014
CSO: 5100/3003

MOCHOVCE NUCLEAR PLANT CONSTRUCTION ACCELERATING

Prague RUDE PRAVO in Czech 25 Oct 83 p 3

[Artical by Miroslav Zeman: "Determination to Overcome the Difficulties"]

[Text] "Today's meeting of the project's management will be lively," predicted Engineer Jan Rajzinger, director of the Slovak Power Industry Investment Plant (zavod Investicni vystavba energetiky Slovenska). "It is high time that we agree on the contractor, and on the further course of construction for expanding the main generating units."

The entire problem actually would not be a problem had the preparations for capital construction been made with sufficient lead time and been of suitable quality. But when preparations did not proceed in this manner on such an important project as the Mochovce nuclear power plant, in the last week of September the project's management was forced to adopt measures for starting work on the project almost immediately.

Compromises

Originally the excavation work for the expansion of the main generating units was assigned to the second project. However, the coordination of extensive blasting with pouring concrete for the structures is not only a difficult task, but also strict safety regulations have to be observed in blasting, and this would have required systematic interruption of concrete pouring, and evacuation of the personnel and equipment. The impact on the economics of construction and on the rate of progress would obviously have been great. Initially both principal contractors for the construction work agreed to the inclusion of the excavation work in the first project: Vahostav [Vah Valley Construction] of Zilina, which is responsible for the first project, and Hydrostav [Hydraulic Engineering Construction] of Bratislava, which is responsible for the second project that includes the actual buildings for power generation.

"At this stage we really are unable to include the entire volume of blasting and excavation in the first project because this would clearly jeopardize its completion on schedule," said Engineer Vojtech Belcak, director of Vahostav's No 03 plant. "If no one tells us today when concrete pouring is to begin, we cannot guarantee that we will be able to blast and remove about 280,000 tons of rock by the time required. If during the placement of the concrete we are able to use only small charges, excavation work will be lengthened considerably."

The management of the project was confronted with the difficult task of finding a way out of the situation that had arisen. What did Engineer Rajzinger have to say? "We understand the standpoint of Vahostav's representatives. Its workers have really started this project successfully and do not want to be left holding the bag later for slippages. But neither we as the investor nor the other contractors can accept this. The project must continue, and excavation for the mentioned building must begin."

Willy-nilly we come again to the problem of preparations. While other projects follow an organizational plan of capital construction, specifically the critical second project has only quarterly operational plans due to delays in preparing the planning and design documentation. This introduces tensions in the relations among the partners and causes no small difficulties. The preliminary plan for this part of the project should be ready by the end of this year. If Energoprojekt of Prague keeps its word, it will help matters considerably. At present it still owes the project a so-called concurrent schedule, a sort of organizational plan for coordinating blasting and concrete pouring. Specifically this is the key to momentarily the most important problem on the project. The construction workers must know whether or not blasting will damage the foundations of such an important investment project as a nuclear power plant.

However, the questions of coordinating the work in progress cannot be limited to the key points of the first and second projects. In its own way also the fourth project, construction of the railroad siding, or the sixth project, construction of the access road, influences progress on the other projects. The intertwining of activities requires not only good coordination of the investors' work, but also much mutual understanding on the part of the contractors.

It must be admitted that on the construction of the Mochovce nuclear power plant this understanding does exist, in spite of all the difficulties, both mentioned and unmentioned. Up to now the situations that threatened to erupt into conflicts have always been resolved, in favor of the investment project. And so far all contractors have been performing on schedule.

An indication of the investor's good organizational work and of the construction workers' willingness is that the situation described in the introduction was resolved at the mentioned meeting of the project's management, through a compromise suitable for the contractor and for smooth progress on the project. The plans for the expansion of the main buildings will remain unchanged, and only the budget will be divided into two parts. Vahostav's construction workers saved on the costs of the first project, and the investor will pay them from the first project's allotment for what they excavate up to the commencement of concrete pouring; they will do the rest of the excavation as a subcontractor of Hydrostav, the principal contractor for the second project.

Not Only Wrinkles

The power plant's construction, even though still in its starting stage, is a huge undertaking. Investment projects of this size often encounter unexpected problems that must be solved as they arise. Such problems have been encountered, for example, by the workers of Doprastav [Transport Construction] who are building the railroad siding, on the section exiting from the perimeter of the

Kalna nad Hronom station. In spite of this, work on the railroad siding, so important for further progress on the power plant's construction, is proceeding successfully. Construction of the access road from Kalna is likewise on schedule and of suitable quality. Here the workers of Doprastav have been able to bring the road's scheduled opening ahead by two months. The Building Construction (Pozemni Stavby) Enterprise of Nitra is doing truly good work on building accomodations for workers in Levice.

Proof of the contractors' good attitude to the investment project's needs is also the fact that they do not hesitate to undertake additional work. For example, Vahostav is doing a considerable volume of construction work on the second project, the main generating units, and is preparing to build several more structures that are not included in the second project. Doprastav of Bratislava will build other induced investments, a small hydroelectric power plant in Kozmalovce, for example.

Although the construction workers are playing first fiddle at present, they will soon be joined by the first supplier of the technology. That will be the Sigma Concern, whose workers will arrive in December to take over the construction work on the nuclear power plant's pump station in Cerveny Hradek.

Winter is just about here. That, together with the rising number of construction workers, is increasing the demand for social services. If we demand high performance of the people in their work, we must ensure for them opportunities for rest and recreation, which means good-quality housing, meals, transportation to and from work, etc.

An entire small town has arisen this year directly at the construction site. It was built by the workers of Hydrostav. In addition to accomodations, there are also a cafeteria and snack bar, so that meals are not such a pronounced problem as they were a few months ago. Tests of the drinking water from the new water supply system also are promising. When we last visited the construction site, acceptance proceedings were taking place for the 17-kilometer gas pipeline that will supply the gas with which the buildings will be heated in winter. On the whole, however, it must be admitted that the construction of buildings for social and operating services does not have much lead time over the need for them, and this is not good from the viewpoint of future prospects.

Construction Site's Pulse

As more working collectives arrive to enlarge the family of the [illegible] power plant's builders, also the party organizations are gaining in strength. Communists are arriving from Jaslovske Bohunice and other socialist investment projects. With them arrive also the young party members and candidates for party membership who will undergo their baptism of fire specifically here. All the party locals and the all-site committee of the CPSL are already over the period of groping that accompanies every start under new conditions, with new people and a new aktiv of officials, who get to know one another in the course of fulfilling their tasks. We have primarily the kraj and okres party organs to thank for successfully raising the quality of party work to a high level within a short time. They performed well a good deal of political and organizational work.

The all-site committee of the CPSL is performing already now its full controlling function. It oversees fulfillment of the investment project's set objectives, and at the same time is devoting attention to normal party life within the party locals, to party education and the activity of the party groups. It is not neglecting also the activity of the social organizations. It sees to it that particularly the trade unions do everything possible for the fulfillment of the workers' social demands. The planned formation of an all-site committee of the Socialist Youth Union is likewise very promising. Briefly put, things at the construction site are lively. The Communists are feeling the pulse of the great project.

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CSO: 5100/3003

PROBLEMS CONTINUE AT JASLOVSKE BOHUNICE NUCLEAR PLANT

Bratislava PRAVDA in Slovak 29 Oct 83 pp 1, 2

[Report by PRAVDA editor Dusan Stancek: "The Investment Project Must Feel Everyone's Input"]

[Text] The tasks for the builders of the V 2 nuclear power plant's first generating unit are running out. In its latest progress report the managing staff established that the third hydraulic test of the power plant's primary loop could probably begin on 29 October of this year. That will be followed by a second inspection, after which there will be only the physical and power-generating startup of the generating unit. But the truth of the matter is that each of the tasks is extremely demanding, and they crown the efforts of thousands of construction and installation workers over a period of several years. And thus although there are fewer tasks, they will decide everything.

During one of our regular visits to the construction site we already established that time was one of the construction workers' adversaries in this stage. This statement remains valid even now. The greatest attention is being focused on the installation workers from the Industrial Automation Plants (Zavody priemyselnej automatizacie) of Bratislava who are completing the debugging, testing and adjustment of the measuring circuits. During the third hydraulic test, all installations and subassemblies will already be functioning in the same way as during normal operation of the power plant; the normal operating temperature and pressure will be attained everywhere, although the reactor will not yet have fuel cells with nuclear fuel, only dummies. The work of the Industrial Automation Plants is specific. As the last of the suppliers of final goods and services, it must cope with the problems and difficulties of the preceding suppliers in terms of time, when each of the participants already feels the pressure of the nearing final completion date. If any of the preceding suppliers hesitates, it too must necessarily wait. Naturally, if to this there is added also the enterprise's own shortcomings and mistakes in coordination by its own ministry, which unfortunately did happen, then the pressure before the final bell becomes even greater. The role of the investor--Bohunice Power Stations, Capital Construction Plant--is that much more demanding in directing and coordinating the final work between the suppliers of the technology and of the construction work. Prior to the commencement of the third hydraulic test, the workers of the Industrial Automation Plants have to complete installation work in 340 rooms, which they then must transfer to the construction workers to finish interior decoration and the laying of the floors. Of the total number

of rooms, the construction workers will receive only 193 for finishing. "Even though this is a bold statement, I am convinced that we will have completed by the time the test starts all the rooms transferred to us for completione," contends Engineer Ernst Jancina, director of the Hydrostav Plant in Jaslovske Bohunice. "We will finish the three remaining premises in accordance with the individual stages of the test and of the subsequent inspection, in a way that will not affect the quality and duration of the test."

Favorable Examples of the Attitude to the Project

As Engineer Ivan Kubicek, the head of a department within the Capital Construction Plant, informed us, the investor so far has placed emphasis on the completion of installation work and has created conditions for speeding it up. Now emphasis is shifting to finishing operations by the construction workers.

The workers of Chemont [Chemical Installations] Brno have repeatedly demonstrated their attitude to the construction of our first nuclear power complex in Jaslovske Bohunice. For example, in installing the stainless steel lining of the spent-fuel basin, despite certain problems that arose even before the commencement of installation work. By working continuously on workdays and holidays, they have been able to achieve that today the basin is not a bottleneck for the startup of the power plant.

In the secondary loop of the power plant, the generating room with the turbines, the critical target date was 30 October of this year. The first turbogenerator was tested on outside steam ("borrowed" from the V 1 nuclear power plant) already on 15 October. The second turbogenerator is being phased in experimentally this week. The tests so far unambiguously attest to the good work of the Skoda Works' installation workers.

After a dispute of several years on keeping the working premises clean, a 30-member group was formed late last week on the initiative of the all-site committee of the CPSL. It consists of construction workers, and workers who are installing the technology. "Cleanliness at the workplace reflects the attitude to the investment project, but it indisputably affects also the quality of the work performed," claims Jozef Jediny, the official of the CPSL Central Committee responsible for maintaining contact with the all-site committee of the CPSL.

We cannot help but concur with this view. Anton Srdos, chairman of the all-site committee of the CPSL within the Capital Construction Plant, also supports this view and adds: "Even before the start of the third hydraulic test, the party locals and party groups of the CPSL will hold public meetings. Their purpose will be to mobilize all the participants for the final push to complete the investment project. We will again emphasize the importance of maintaining labor discipline and cleanliness at the workplace."

Construction of the V 2 power plant's first generating unit is behind the schedule set by the government. Therefore it should be a question of honor for every construction worker to contribute by their responsible work toward narrowing the gap between the scheduled completion date and the actual date when the power plant is placed in trial operation.

Have We Again Failed to Learn Our Lesson?

A glance at the fulfillment of the schedule for the construction of the V 2 power plant's second generating unit creates an atmosphere of optimism. By mid-October, the construction workers fulfilled all their tasks. But it seems that the problems have yet to come, and the situation at the construction site confirms this. Delivery of the last steam generator, from the Klement Gottwald Iron and Engineering Works in Vitkovice, slipped by two months. Delivery of the pressurizer will likewise be delayed. Installation of the technology is behind schedule by 2 or 3 months, because the capacities are tied down with the completion of the V 2 power plant's first generating unit. By 31 December of this year, the builders must complete the construction of the reactor hall. The task of the suppliers of the technology and installation work is unambiguously clear: to make up for the time lost. And what about the construction workers? "The delays in deliveries are causing considerable problems for us. We have not learned sufficiently from our past mistakes, and the work is again piling up. But we will have to fulfill the set tasks," said Engineer Jancina.

Let us add that all participants must fulfill their tasks, at least in the volume agreed upon, which is an important qualification. Behind it lies that failure to learn our lesson: Also this project will be completed, at the price of improvisations and stopgap solutions in supplier-user relations, in a flood of additional costs, through excessive effort and at substantial inefficient financial outlays. To the detriment of entire society.

1014
CSO: 5100/3003

V-2 NUCLEAR PLANT CONSTRUCTION PROBLEMS VIEWED

[Editorial Report] Prague RUDE PRAVO in Czech on 22 November carries on page 3 a 1,400-word article by Dusan Tallo, from the West Slovak Regional Committee of the Slovak Communist Party [CPSL]; Anton Srdos, chairman of the CPSL's construction-site committee at the V-2 nuclear power station in Jaslovske Bohunice and RUDE PRAVO editor Gustav Capko. The article is entitled "In the Struggle With Time, Quality Counts, Knowledge and Experience Acquired From the Construction of the V-2 Nuclear Power Station in Jaslovske Bohunice Must Bear Interest"; and is critical of the current situation at the site of the V-2 nuclear power station.

"Despite the utmost efforts of the people working on the site," the article states, "which have almost reached the limits of human endurance," it is "still uncertain when the first block can be connected to the power grid." While the deadline is the end of this November; according to the article, "it is already obvious that it will not be met," since "despite the work of thousands of workers, and their unprecedented efforts they did not succeed in coping with all the scheduled tasks."

"The lag," the article states, "is currently 2-3 months; in the earlier period, the immense size and significance of this project were underrated, its problems were not dealt with in time and consistently, and this is the main reason why the first block cannot be put into operation within the government deadline. This is also why the measures aimed at ensuring the planned deadlines for the second and third hydro-tests, which were adopted at the June and August coordinating conferences of the ministers of involved branches and of the representatives of other agencies and organizations, were not as effective as expected. Moreover, the construction project itself showed certain significant shortcomings. Practice has confirmed," the article continues, "that the planned experiments and tests that are imperative for the secure and reliable operation of the electric power station cannot be substantially cut short in the concluding construction stage, not even by an increase in manpower."

The failure to adhere to the schedule was also due to the fact that, "for a considerable period, supplier-consignee relations and conditions for smooth work were not meeting the requirements," the article states, so that "only the first hydro-test was started and concluded" according to schedule; the second test showed a 1-month lag, and the third and last test began only

during the last days of October. After expressing appreciation for the emphasis placed on the quality of all operations by the various organizations involved, the article stresses the need to adhere to working discipline and order in every sector of the project; "it would help matters," the article goes on to say, "if the organizations involved in the construction of the second block immediately approached the realization of the set tasks with the same resolve. This important project which, according to the government deadline, is to become operational by the end of February, is also progressing under similar conditions and with similar difficulties. It is necessary to make the knowledge and experience acquired in the preceding period count; likewise, the capital must be used for the benefit of the entire society.

"For instance," the article points out, "it is impossible to be satisfied with the fact that all priority tasks had, in essence, been completed by the middle of October. The current nature of the problem, the 2-month lag in the delivery of the last steam generator from the Klement Gottwald Iron and Engineering Works in Vitkovice, a similar situation in the delivery of the volume compensator, and the 2-3 month lag in assembling the equipment all indicate that the serious problems are yet to come. At the same time, the reactor hall is to be ready, in terms of construction, by the end of this December. Will they be able to cope?"

The article concludes by saying that "the lag in deliveries of equipment and in the assembly work evokes concern whether deadlines set for this block will not also be delayed in the final phase. Once again we have a large accumulation of work, and a repeti ion of the mistakes which accompanied the construction of the first block of the V-2 Nuclear Power Station."

CSO: 5100/3004

NUCLEARIZATION OF SOUTH ATLANTIC DISCUSSED

'Omega' Comments

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 10 Dec 83 p 6

[Article by Roberto Godoy: "South Atlantic: Nuclearized Area"]

[Text] Rome--Latin America has already entered the nuclear arms race. At least four countries in the area will have the technological capability to produce nuclear weapons on a regular basis within an average of 5 years: Argentina, Brazil, Chile and Cuba. More serious: in the same geopolitical region, South Africa may now have a large nuclear arsenal stockpiled at the secret military base at Simonstown. Buenos Aires will have an operational bomb in 1988 if the strategic goals of the National Atomic Energy Commission [CNEA] are maintained. The commission's goal is to produce a 20-kiloton bomb, to be launched by plane, probably the Mirage IV supersonic bomber, the former French nuclear vector, which the military government had secretly been attempting to purchase since June of 1982.

The specialized know-how has in some cases been acquired through the contracting of highly qualified technicians who rent their services temporarily and who are known as the "Omegas," an adjective borrowed from the jargon of the weapons market, where it is used to indicate the most competent executives. There have been associations between these professional mercenaries and researchers from countries interested in experimentation, but who cannot operate in their own territory. A program of this type, employing several "Omegas" and Israeli scientists, is pointed out as the determining factor in the quick success of the South African project. There is a problem, however: although it has a reasonable tactical force, the Pretoria Government received the devices ready-made, in the form of "black boxes" with regard to several basic aspects, and until it assimilates the corresponding know-how, it cannot duplicate the stocks.

A slower program was that undertaken by Chile, since it was heavily impeded by the country's economic difficulties. In Cuba, however, the process of building a reactor for academic research actually may have encompassed a plan to give Havana, within a relatively short time, the means to master the stages in the production of nuclear fuel--one step before the bomb, the point at which Argentina stands today. About 80 Cuban physicists are working on the project.

O ESTADO and JORNAL DE TARDE received the information from physicist and nuclear chemist Giorgio R., probably not the real name of this small man. Presumably 45 years old, a smooth talker who has already worked in Iraq, Pakistan, Libya

and South Africa, Giorgio learned his trade in England and the United States, but does not divulge his formal degrees. Giorgio is an "Omega."

Precious Aid from 'Omega' Scientists

The small elegant figure with gold-rimmed glasses, an impeccable three-piece suit and fine silk tie is quite a contrast to his huge companion, dressed in scruffy blue jeans, paratrooper boots and yellow nylon windbreaker. On this cold, sunny morning in Rome, only the restaurants in the Piazza Navona are open for business.

"My name is Giorgio P. May I sit down?"

The planning for this meeting had begun in Sao Paulo, 2 months earlier. The taller man is a former military attache with his country's embassy in Brasilia. He was the one who arranged the whole thing, after he had mentioned, in a casual conversation, that he had ties with the mercenary scientists who provide their services to those who are interested not only in the basic nuclear technology but in many other areas of the manufacture of weapons, ammunition and propellants. Now, 22 meters from the Brazilian Embassy in Italy, he makes the introductions and quickly departs. Giorgio orders coffee, cognac and grilled cheese with pepper. The waiter smiles, eyes his watch and shakes his head. It is only 8:30 am.

"First of all, I want to say two things. First, I do not teach anyone to build atom bombs. If I did that I would be very rich. What I know is one of the many things that are not found in the books--refined nuclear chemistry. Second: I have never in all my life worked on a program that was not directed toward the production of energy or on one that would result in a weapon. And that is why I decided to talk to you."

Giorgio P. says he is Italian, but his accent, although slight, betrays Anglo-Saxon origins. He finishes his unusual breakfast and decides to take a stroll. He talks about the geraniums that cascade from the window boxes, the ochre color of the old Roman houses, the "palazzo" that shelters the Brazilian Embassy and the obelisk "stolen from Egypt." Slowly, the information begins to come out, prompted initially by a newspaper article: a NATO general has declared in Brussels that the installation of the Cruise and Pershing II missiles is essential because the already existing Soviet SS-20 missiles can cover the entire western side of the continent except for the Algarve coast.

"Lucky Portuguese," the "Omega" says sarcastically. "Even if there is no direct hit, the inhabitants of the Algarve will directly feel the effects of a massive attack. There is no escape. It is fatal." According to Giorgio, the East-West discussion is "rhetorical." In his opinion, the risk of total war comes from the Third World. "Here in Europe, we are controlled. The hotheads are in the Middle East, in Asia, in North Africa and now in Latin America. And many of them will soon have nuclear buttons to push."

The specialist says that "to consider the South Atlantic, the Caribbean and the South American region in general as free from the strategic arms race is to be like the ostrich, burying his head in the sand to avoid seeing the danger." According to Giorgio, the situation today in the various countries that--according to his "privilaged" information--have military goals can be described as follows:

South Africa--In 1974, Louw Alberts, then vice president of the Atomic Energy Commission, announced in Grahamstown that if his team had not yet produced an atom bomb it was solely because the government had determined that nuclear knowledge should only be used for peaceful purposes. The situation in the country has changed considerably since then. The same commission decided soon afterward that a powerful deterrent was needed to confront the border and internal problems that were responsible for a continuing state of war. The choice was for low-potency tactical weapons, but these are as difficult to produce as the big ones--over 30 kilotons. The problem of miniaturization was solved by contracting some "Omegas" (German and Dutch, mainly) and through binational collaboration with Israel, whose scientists were interested in conducting some research but could not do so on their own, highly visible, territory. The prototypes were ready in 1979, but the information was leaked. The planned test was postponed, but then a providential atmospheric phenomenon known as "flash" helped make it possible to categorically deny the existence of nuclear weapons in the area. The huge flash on 22 September was explained as an event of magnetic origin. Some months afterward, the weapon was tested, but in a computer simulation. At this time South Africa is equipped with an arsenal of 8 to 10 bombs of 3 to 10 kilotons. The vector is the 155-mm G-5 cannon, which is also for conventional use. The tests were conducted secretly on the island of Antigua, in the Caribbean. The G-5 can be used as a cannon, mortar or howitzer. Its firing range is from 30 to 35 kilometers. Its fire,computer-controlled, is at a rate of 3 discharges per minute during a 15-minute period, with intervals of cooling. The weapon has a self-propelled configuration, the G-6 Rino, which also has a 155-mm cannon. It weighs 30 tons, is 10.2 meters in length and 3 meters high. It travels on wheels at 90 kilometers per hour and has a range of 450 kilometers. It is armored against radiation, chemical or biological attack. Its nuclear charge, denied by the South African authorities, reaches 37,000 meters; the missile is aided by a special propellant. When it was officially presented, Cmdr J.A. Marais, president of the South African war industry, declared that the Rino was able to carry "standard U.S." nuclear ammunition. The most recent plan of the Pretoria military is to make it possible to mount this type of weapon on two frigates and to build a gravity bomb, smaller than the one dropped on Hiroshima, possibly in the area of 12 kilotons. The transfer of "closed" technology by the contracted technicians is coming to an end. It is expected to be completed in 1984.

Argentina--Vice Adm Castro Madero publicly admitted that the Argentine Navy wants a 4,000-ton nuclear submarine, of the English Superb class. To this end, it is going to develop a compact, enriched uranium cold water reactor. According to Giorgio P., this is not all. One of the secret projects of the CNEA is a gravity bomb (to be dropped from a plane), with specifications yet to be determined--but on the order of 12 to 20 kilotons. This weapon is Buenos Aires' response to the very probable characterization of the Falklands-Malvinas archipelago as the base of support for British atomic submarines. It is also one of the less complicated devices to produce, but it requires a manned and efficient launcher. Therefore, according to Giorgio, the Air Force has also initiated secret negotiations with France to acquire at least five Mirage IV supersonic bombers, which until last year were the principal strategic vector of the "Armes de L'air." Of the 33 still in use, at least 10 will be updated by the manufacturer, Dassault industries, and then sold as conventional penetration bombers or electronic observation aircraft. With advanced electronics, the

Mirage IV's can, for example, reach Port Stanley, the capital of the islands, without difficulty, or any point in the south-southwest of Brazil.

Cuba--This is a new venture, only 2 years old, "an attack move on the chess board between the United States and the USSR," Giorgio says, speaking of Havana's nuclear program. The plan is to train Cuban specialists so they can create a Cuban nuclear force without direct Soviet assistance. The official argument of the Castro government is the energy shortage in the country, which has limited hydroelectric resources. The first results will take at least 10 years. At the moment, there are 80 technicians in training in the Soviet Union. According to the "Omega," "it is a subtle way of maintaining a nuclear base on the doorstep of the United States and in the middle of the Caribbean. Ultimately, if Havana decides one day to produce military weapons, it will be at the will of a sovereign and recognized government."

Chile, Peru--Some of the Argentine projects for application in defense missions have been developed using Peru's reactor, operated jointly with the CNEA. In Huarangal, a 10-megawatt unit is in operation. In October, there were job opportunities for physicists, engineers and specialists in uranium metallurgy at the Peruvian Institute of Nuclear Energy. In Chile, the work has been discontinued. Advisors of the Gen Augusto Pinochet government came to contract various groups of independent scientists in 1981, but it never went beyond this priliminary stage. However, Giorgio guaranteed that there is a secret document, signed between Chile and "a certain European country," to significantly accelerate the research, which had two goals: to master the uranium cycle and to "insure the nation's integrity."

Regarding Brazil, Giorgio had no comment. He looked at his digital watch, noted that he had been "rattling on for over 2 hours," took a second cup of coffee, got up and left hurriedly. Without looking back, he entered the nearest building to the typical restaurant. It is the Church of St Agnes in Agony.

Former NUCLEBRAS President Comments

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 10 Dec 83 p 6

[Text of interview with Paulo Nogueiro Batista, former president of NUCLEBRAS, granted to O ESTADO and JORNAL DE TARDE, date and place not supplied]

[Text] Ambassador Paulo Nogueira Batista, former president of NUCLEBRAS [Brazilian Nuclear Corporations, Inc], believes that the military nuclearization of Latin America is a reality today, in view of the continuing presence of U.S. and Russian ships with nuclear arms in the South Atlantic, Caribbean and Pacific waters. In his opinion, the principal threat to the regional balance of power lies in the "great possibility" that some of the nations in the area have already decided to invest in the acquisition and development of certain technology for the purpose of producing strategic artifacts. Speaking with O ESTADO and JORNAL DE TARDE, Nogueira Batista pointed out that simply possessing the bomb "does not turn a country into a nuclear power from one day to the next."

[Question] In your understanding, is the Argentine program's goal of building a nuclear submarine feasible?

[Answer] I have heard talk of this plan, and I must say that I see it as a very long-range thing. Argentina's choice (and this is very odd, since its nuclear program has always been directed by admirals; it has always been the responsibility of the navy) is based on a technology which, in principle, is unsuitable for naval propulsion; in this case, you need very compact reactors, and the big drawback of the heavy water reactor used by the Argentines is that it cannot be miniaturized. It uses natural uranium as a fuel, so it uses a large volume. If it used enriched uranium, the volume could be reduced, but this is not the case. All the naval propulsion reactors, and this is particularly true of submarines, burn enriched uranium exclusively.

[Question] Argentina and South Africa have mastered the complete technology of nuclear fuel and are even enriching uranium, and they have secret installations, without any safeguards or international controls. Could they produce strategic weapons at these facilities?

[Answer] A country's decision to become a nuclear power is a much more complex matter than simply producing an isolated weapon. First, it must have an overall military doctrine which encompasses the use of nuclear devices and weapons, more precisely, which incorporates the element of nuclear deterrence in its strategy, because the idea, always, is to have it to avoid having to use it. Then, in addition to this doctrine, which has an enormous impact on all conventional doctrine inasmuch as it is necessary to change the whole attitude regarding the usual means, it is also necessary to have the production line capability, to have suitable vectors and a highly efficient operational support mass, so it is not practical to think you can turn a nation into a nuclear power just because a device has been built at a particular location. It must have a means of transport and, most particularly, it must be able to reach the desired target, and all this with micrometric precision. Well, this calls for a well-designed device; otherwise, all that power is not worth anything. It imples strategic air capability, medium-range missiles or other resources adapted to the existing bomb type, and considerable computer work. So it is not a simple decision; on the contrary, it is one of the broadest and complex decisions presented to a government. Certainly, it is pointless to conduct an isolated experiment (this may have been the case with India, for example, which set off a very dirty, low-powered bomb). It does not mean that the country has joined the nuclear powers of the world.

[Question] But there is a complicating factor in this line of reasoning. Argentina is conducting secret negotiations to buy Mirage IV supersonic planes, France's former nuclear vectors. Would it do so if it did not intend to produce a nuclear weapon?

[Answer] Let us imagine, for example, that a county reached the level of capability to produce a device as good as the "Fat Boy," which the Americans dropped on Hiroshima in 1945. It is an extremely heavy weapon. It would not be feasible to use the Mirage IV to launch it. This operation would call for a real Flying Fortress, and it takes a good deal of competence to reach that stage. The solution is miniaturization, which makes it possible to use a small transport plane... but that is another story...it is necessary to go pretty far, to cover a lot of

ground. It is not something which is quickly accomplished. Before you arrive at this stage there are other problems to solve, in terms of planning the manufacture, in addition, obviously, to a real understanding of the physics of the materials, ballistics, the engineering of an atomic weapon, and on and on. I repeat, to make a bomb does not serve any serious purpose, or rather, it serves just one--to incur the wrath of the entire world.

[Question] Various international institutions for strategic studies and evaluation guarantee that South Africa has established a nuclear arsenal. Is this correct?

[Answer] I do not know about the South African program, and from what I have seen, the reports concern an undertaking directed towrd the generation of energy, which would not lead to the production of weapons, or which could lead to a model, at most, and that would be difficult. Because in terms of money, of manpower resources, the investment is large and continuing. Anyone who goes into this and does not continually upgrade the product is quickly surpassed. We have the case of France: there was a period of 15 years between the stage in which the French researchers could consider themselves prepared to make weapons and the next stage, consolidating their position, to measure up to the concept of a nuclear power.

[Question] Faced with a nuclearization of the South Atlantic, would Brazil be compelled to enter an arms race?

[Answer] But what do you mean by the "nuclearization of the South Atlantic"? To define the region as a nuclearized zone, it is not enough just to have some nuclear devices in the area. If it were just that, the process would be a reality today, because it already happened, a long time ago. I do not have the slightest doubt that North American and Soviet submarines are currently there at all times, armed with nuclear devices. I believe that the greatest threat to the balance of powers lies in the fact that some South Atlantic coastal countries will develop their own strategic capability. But this in itself would not bring forth a Brazilian response on the same type. This is obviously a political option of the government, a high-level decision, which could be the basis of a "yes," "no" or, more probably, "maybe" to a formal proposal in this sense. There would be much prior consideration: first, a realistic evaluation of the power of intimidation; second, an assessment of what this component represents, strictly speaking, for Brazil. Finally, a precise framework would be established to define the solution to the following problem: against whom, and under what conditions, would this bomb be used? The parameters resulting from these studies could well determine a strengthening of Brazil's defense without the need to create a military nuclear force. We have the example of Europe, densely nuclearized, but in which not all the nations decided to acquire autonomy in the nuclear area. At the moment of choice, that group felt it was sell served by other means, [such as] maintaining and broadening alliances. It is an intelligent solution.

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ENRICHED URANIUM NOT SUBJECT TO SAFEGUARDS, SAYS CNEA CHIEF

Buenos Aires LA NACION in Spanish 30 Nov 83 p 14

[Text] The chief of the National Commission for Atomic Energy (CNEA), Vice-Admiral Carlos Castro Madero, stated that "Argentina is not submitting to impositions with respect to enriched uranium" and he emphasized that "the United States is requesting us, is urging us to submit it to safeguards as a national act of our own free will."

"Completely Mistaken"

Castro Madero made statements on the program "Magdalena and the News" on Continental Radio. When commenting on an editorial note in the American daily THE WASHINGTON POST, he said that "it is completely mistaken" when it says that the objectives of Argentina in the nuclear arena are not entirely peaceful.

"The plant is not going to supply a nuclear program of the size mentioned by the article," Castro Madero emphasized. "Instead, in principle it is going to supply the nuclear reactors and our exports in Latin America, which means the volume of the plant will have limited dimensions."

He added "On the other hand, if Argentina did attempt to carry out development for belligerent purposes, it would certainly have to make an enormous investment, which is not the case in Argentina."

Criticism of the United States

Castro Madero underscored the Argentine position of "no acceptance of impositions from abroad" and he criticized the United States for its "mistaken policy, which is based on negative attitudes since it tries to keep countries from having access to nuclear technology. The total ineffectiveness of the policy was exposed clearly by this event in Argentina."

"Discriminatory" Treaty

Castro Madero confirmed that Argentina never signed the Nuclear Nonproliferation Treaty because it considers the treaty "discriminatory because it

recognizes different rights and responsibilities of countries depending on whether they have manufactured an atomic bomb or not. That is to say, it flagrantly violates the principle of legal equality among all states."

"And so," he added, "like the great majority of the Third World countries who have not built the atomic bomb, [Argentina] finds itself among the countries that have gone without or have limited their use of nuclear energy."

Reprisals

Regarding possible reprisals by the United States, such as the suspension of heavy water shipments under Jimmy Carter in 1978, Castro Madero stated that "without doubt there are always elements" whose shipments could be interrupted, but he pointed out that there are "fewer and fewer, because our ties with the United States are practically nil."

He said that "the Argentine position is a great deal stronger now, since the country has the means to continue its work, and the United States also has to be concerned about what Argentina does with the technology."

Nuclear Submarine: "Legitimate"

Regarding the project to build a nuclear submarine, Castro Madero recalled that "the problem of the atomic submarine originated with the war in the South Atlantic, when Great Britain used them."

He pointed out that "Argentina asked for a condemnation of this and received no support." Then it consulted the International Atomic Energy Agency so that the agency would report on "whether it was legitimate or not to use nuclear power for naval propulsion."

Castro Madero revealed that the answer was affirmative and that "it was compatible with a program with peaceful ends." Consequently, Argentina "reserved the right to do so in the future."

12351
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DETAILS SURROUNDING PILCANIYEU FACILITY DISCLOSED

Buenos Aires CLARIN in Spanish 21 Nov 83 pp 2-3

[Article by Ernesto Mones Ruiz]

[Text] San Carlos de Bariloche--Some of us have lived in this city for more than 40 years and, during the final dizzying years of Peronism in the first 5 years of the 1950s, we witnessed the "creation of the atomic center and the possible construction of a bomb under the still inscrutable Dr Richter." The announcement by Carlos Castro Madero, the chief of the CNEA [National Commission for Atomic Energy], that "Argentina has acquired the technological capacity to enrich uranium by the gaseous diffusion method" surely does not produce the same shock as it does in the rest of the country and abroad.

When then governor of Rio Negro Rear Admiral (Ret) Aldo Luis Bachmann placed his signature beside that of Castro Madero, thus creating INVAP (Applied Research Institute), that "something that has been cooking since 1976" began to take shape in the general thinking of those of us who were always turned away because of our profession and its "high rate of indiscretion," as it is described by the same heads of the Pichileufu-Pilcaniyeu area.

The fields were purchased from a ranch owner there "to build the new sections of the brand new agency of the CNEA and transform that desert-like place into an imminent 'development pole in Rio Negro.'"

But very quickly disappointment and the renewed, anxious hope of being rescued from the Patagonian desert began to spread among the country folk and the well-to-do Syrians, Lebanese and Galicians, who make up the majority in that cold, windy place.

At first (in late 1978) INVAP began to develop zirconium sponge, one of many elements that are fundamental to our nuclear plants and that were being imported at a high cost. Over time other activities were added, such as extractive metallurgy, electronic and optical instrumentation projects, special mechanical equipment, etc. All of this is operating at full tilt now and there is a series of interrelated satellite plants.

The majority of the staff, whose total number remains "secret," has settled in San Carlos de Bariloche, except for about 50 persons who work in security and provide services such as plants and the drinking water supply, among others.

The road has never been paved. Only an access road to the mysterious plant was built from National Highway 23, barely 8.5 km from Pilcaniyeu.

The staff reaches the desert area in various vehicles from Bariloche, and the laborers and workmen make the trip daily using a special train service that ends at the Pichileufu stop.

Pilcaniyeu, the "development pole," is the same as it was in the 1930s, when the single rail "state" train from Carmen de Patagones to Bariloche passed by the hamlet of adobe and wild straw. That community is still awaiting the establishment of new sources of employment and its definitive integration into the province and the country.

Another outstanding project undertaken by INVAP was the construction of the 500 kw, RA-6 nuclear reactor for research and education. It is already being used by the Balseiro Physics Institute here in Bariloche.

Finally, it should be noted that INVAP, a semipublic enterprise, receives no financial support from either Rio Negro or the CNEA because, say its directors, its funds "come exclusively from income earned from its work" and also from "feasibility studies" that it carries out on commission.

Among the former, it should be recalled, was its participation in the construction of instrumentation for the Peruvian medium power nuclear reactor.

INVAP currently is, and always has been, run by a board of directors under Corrado Barotto.

Barotto has always characterized himself as "totally secretive about everything related to INVAP, keeping at arm's length anyone who claimed to represent any news medium, constantly citing that matter of 'national security' or 'state secrets'."

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POSSIBILITY OF PRODUCING BOMB BY 1990 DISCUSSED; REACTION

Preparations Under Way

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Dec 83 p 5

[Article by Roberto Godoy]

[Text] The Brazilian nuclear bomb is theoretically defined, and the date has already been established for adopting a decision about its construction: 1990. It is at that time that the military scientific research bodies and the civilian research institutions in the atomic sector will have completed a long process of acquiring knowledge and training personnel to provide the country with total technological independence in this sector. Everything will then depend on the determination of the government to establish the terms of a possible program designed to create a nuclear-equipped tactical and strategic security force in Brazil.

In 1990, the energy question will have been resolved thanks to this same joint effort, the experts currently involved in the undertaking believe. That is also when it will be possible, based on the pressures in the geopolitical framework at that time, to opt for the establishment of deterrent capability through the bomb. In such a case, the country would have "reasonable atomic capacity" by about 2005, but it might have the first mass-produced operational product by 1998.

Brazil's main strategic nuclear weapon would be a 20- to 30-kiloton bomb (two or three times as powerful as that used at Hiroshima in 1945) made using plutonium, and launched by an immense missile 16 meters high. It would weigh 40 tons, in the medium-range ballistic missile (MRBM) class, capable of carrying a warhead of more than a ton for about 3,000 kilometers. This is the military version of the satellite launcher vehicle (VLS) developed by the Space Activities Institute in Sao Jose dos Campos, initially to carry out orbital missions at an altitude of 600 kilometers in 1989. In its military form, its use could be compared to that of the French S-2, although it carries a load of smaller size.

Tactical interests for the army point in the direction of a rocket with a nuclear head of up to 12 kilotons, an inertial guidance system, and a range of 240 kilometers, similar to the Soviet SS-1 Scud. Very mobile, mounted on a fast, semi-armored vehicle on wheels, which would also transport the

hydraulic launching ramp, this weapon would be intended for f eld use, along with the atomic 155mm gun (with 4-kiloton projectiles) of the G-5 type developed by South Africa.

In the navy, which is pursuing the most sophisticated program, the goal is the production of a very complex compact reactor to serve as the propulsive element for a nuclear submarine displacing 4,000 tons, equipped with heavy torpedoes and missiles, which is planned for the end of the next decade, as the money for investment in new laboratory experiments becomes available.

This information was confirmed and partially completed for O ESTADO and JORNAL DA TARDE by five high officials in the air force, army and navy, who are directly or indirectly affiliated with the research and the design of the various strategic aspects. Only two met with us simultaneously, but in all our talks the complex of data remained consistent on the basic points, and details. According to these same sources, the situation can be defined in terms of two points.

1. Until the turn of the century, there will inevitably be at least two nations equipped with atomic weapons in the South Atlantic--Argentina and South Africa, apart from Cuba, in the Caribbean.

2. The shortage of certain natural resources in the future will require new national defense commitments in the next 20 years on the part of countries which, like Brazil, have a reasonable abundance of these raw materials.

The government gives assurance that there is not in the country today any formal "bomb project," nor will Brazil be the first to install nuclear artifacts of war. But neither will it interrupt its personnel training efforts nor will it abandon the effort to achieve mastery of all phases of the technological process in this field, including its military aspects.

The trumps up the sleeve which would make this desired sovereignty possible are not related to the agreement with Germany, but are focused, in a proportion estimated at more than 80 percent, on the Aerospace Technology Center (CTA) in Sao Jose dos Campos. It is there that parallel development is proceeding on the project involving uranium fusion-enrichment through excitation using laser beams; the manufacture of plutonigenic rapid reactors, using thorium as fuel; and the development of a linear electron accelerator. In addition to this, it is also at the CTA that the largest computer on the continent, a Cyber 170/750, is installed. It is capable of processing 10 million instructions per second, and is extremely well-suited to nuclear data bank processing.

"None of these undertakings alone could lead specifically to an atomic artifact. But the combination of all of the items, associated with our potential, will provide access to a level of knowledge which is normally not transferred, and without which the country cannot do," one of the officers said by way of analysis.

In fact, this same line of thinking is shared in Buenos Aires and in Pretoria. According to one nuclear scientist interviewed by O ESTADO and JORNAL DA TARDE in Rome, the two nations could at any time undertake the role of "atomic guards" of the South Atlantic.

Secret CTA Preparations

The sign on the uncertain shoulder of the Tamoios road says only IEAv, and from the roadway, one can only see the empty main gate. There is little pomp to this secret and solemn place, the CTA Institute of Advanced Studies, from which, within 10 years or perhaps even less, a viable Brazilian nuclear bomb may emerge.

In the reception area there are professional security guards. The checking of the identity of visitors is definitely not a routine procedure. Several telephone calls are made for confirmation, a cup of coffee is promptly served, and lists are consulted. One warning: one may not bring in still or moving picture cameras or tape recorders. The chief guard designates a man to accompany each vehicle entering the area. The young man, discreetly and "accidentally," allows a cigarette pack to fall to the ground. He bends to retrieve it--and takes advantage of the opportunity to examine the space beneath the vehicle seats.

The atmosphere changes beyond the 300 meters of the access avenue which is divided by a row of palm trees. There is much movement within the low, elongated structures. Men and women, for the most part young, are crowded into the buildings distributed around a circular court. The majority of the installations, such as for example that which shelters the Cyber 170/750 supercomputer, in the heart of the IEAv, are off limits.

Getting as far as the system requires a new cycle of security checks, this time by the in-house team, which is large and strategically distributed around the lobby of the data processing center. Following the check, a short maze leads to the underground area. A closed steel door operated electronically will only open when a letter and number code is punched into a panel. The three flights of stairs are reinforced concrete, and finally there is another door and another code. The bar of the door is removed, and at the end of the passage, an armed guard waits.

The pressurized atmosphere has filters in the air intake, and can resist the impact of direct bombardment, apart from having its own special energy generators. And all of this to keep the vast machine occupying the underground level in operation. It is an impressive complex, 10 times larger than the most sophisticated of the computers in operation at the other research institutions in the country. The Cyber 170/750 operates at a speed of 10 million instructions per second, and its memory can accommodate data totaling up to 262,000 60-bit words, providing 15 simple or 29 double precision digits. It is in this complex that all of the instructions on nuclear matters, classified and otherwise, are being stored in an inaccessible program. However this is not the priority task of the equipment. In fact, the Cyber is used to process the gigantic equations of the CTA's advanced meteorology analysts,

to design, to simulate electronic circuits, to produce texts, to calculate structures or to carry out the multiple tasks required by the users of the 60 remote terminals hooked up full-time. A modular mechanism, the 170/750 can be further enlarged, and like spaceships, it is cooled by freon gas.

Near the surface there is a dominant image--the hexagonal tower in the center of the court, the heart of the master plan in connection with which the designs for the future call for six building wings. Isolated in the IEAv perimeter, there are 300 researchers--physicists, engineers, chemists and mathematicians. Are they engaged in the secret production of atomic artifacts? One of the scientists had a categorical answer to this question. "Definitely not. Our effort in this field is to develop national training. The use of this knowledge in the long run will be the responsibility of those in the government at the time." This same technician admits, however, that "there is a single common stem in the development of weapons and the generation of energy by nuclear means. The joint work toward both ends runs to more than 98 percent."

And this same reasoning is defended by a highly placed civilian authority in the energy sector, in whose view "any other choice would mean submission and dependency, not on the small countries which own the oil and are members of the OPEC cartel, but where atomic energy is concerned, only to the two superpowers who have this technology."

Death and Delays

The history of the sophisticated IEAv records two major deaths under tragic circumstances. The first was that of physicist Sergio Porto, who was responsible for the discovery of a brand-new method for the isotopic separation of uranium using laser beams. At the invitation of Col Jose Albano de Amarante, director of what was then the Advanced Studies Laboratory (LEA), the scientist planned to leave the UNICAMP [Campinas State University] to work for the CTA, where he would broaden his research. First, however, he decided to visit the Soviet Union in response to an invitation from the USSR Academy of Sciences to present his work. On the night of the special session, Sergio Porto was honored by that institution. He went to bed, much moved. The following day there was a soccer game. The extreme cold demanded of his heart a great effort of which it was incapable. Few individuals were aware of it, but the physicist suffered from minor cardiovascular trouble. He had a massive heart attack at the age of 53.

A short time later, Colonel Amarante, who conceived the ideals of the IEAv, an ideologist of the philosophy of action and the man mainly responsible for its new (in 1981) prerogatives, traveled to Europe. On his return, he was diagnosed as having a serious and irreversible illness. Prior to his death Amarante would go on to define the basic guidelines for various projects, including the data processing center and the fast thorium reactor. The cost of the loss of these two scientists in terms of delays is estimated today at 5 years out of the initial time schedule.

The CTA Is a City

A fine hotel, barber shops and beauty parlor, international postal agency, telephone switchboard, gasoline station, restaurants, American bar, athletic field, theater, cinema, churches, schools, supermarket, hospitals, banks, airport, library, laundry. The 6,000 persons who keep the CTA operating live and work, or just work, in an ecological park of 12 square kilometers, designed by Oscar Niemeyer. It is a city, outside Sao Jose dos Campos. It is the largest technological production institution in the country and "so quite correctly committed to the pursuit of Brazilian autonomy in the sensitive nuclear area as well." Thus it was defined by one of the officials O ESTADO and JORNAL DA TARDE sought out. The continuity of this effort seems guaranteed. The present director, Brig Gen Lauro Ney Menezes, who has done broad and outstanding research work, will be succeeded in January by Brig Gen Hugo Piva, the "father" of the space programs and a respected military scientist.

Fast Reactor Now Approved

The route leading to research of building of a fast breeder reactor and the manufacture of military artifacts was marked by the singular characteristic of this energy equipment: the capacity to produce plutonium, Pu-239, which is fissionable and not found in nature. It is the critical element in a nuclear bomb.

Fast reactors, unlike the conventional type, have no regulator (used to reduce the speed of the neutrons and to facilitate their collision with an atom of uranium 235, initiating fission), and they function basically with neutrons moving at a little less than 16,000 kilometers per second. The nucleus is small and there are few materials in the system which absorb neutrons, thus considerably increasing the yield. Although the dimensions of the whole are small, it generates great heat--and it is at this point that the main difficulties in operation arise. They involve achieving a cooling environment consistent with safety, while also achieving good performance in transferring the temperature obtained to the pressure receptacles where it can be converted in a traditional way to energy.

In the United States and in England, liquid sodium is being used, but without notable success. In France, which has had a vast fast breeder program for some years, the problem is reported to have been resolved with plasma, but this has not been confirmed by the Atomic Commission in Paris. The same solution was reported in the Soviet Union in 1982, during the holding of an international physics symposium.

The basic reason for Brazil's reliance on this thesis is the fact that our country contains the second-largest known reserve of thorium on this planet, and because fast reactors can actively use this radioactive metal, which is found in monazitic sand. And what happens? When bombarded by slow neutrons, thorium simply does not absorb them. But if the bombardment is faster, with an energy level of 4 milliwatts or higher, the particles are incorporated. The substance is then transformed into thorium 233, which gives off beta radiations, undergoes another transformation and becomes uranium 233, which

is not found in nature but can serve as a more efficient fuel than uranium 235. Another residue from the usual process, uranium 238, which is also affected by fast neutrons, releases a beta particle and is altered to become plutonium 239. In this way, when the reactor consumes its load, it is also creating new fuel on the basis of the uranium or thorium placed within it or around it, like a metal "blanket."

The resulting byproducts can be chemically separated and reused, in other units, for example. Other advantages include the fact that the fast breeder effects as many fissions in one month as a thermic reactor does in a year.

Since it produces twice as much fissionable material as it uses, the fast reactor is also a notable source of critical mass for nuclear bombs. Finally, 10 kilograms of plutonium suffice to create a relatively simple, but devastating artifact. And for each megawatt of electricity generated by a breeder reactor, 250 grams of Pu-239 can be obtained per year. Twenty-five megawatts is normal for an experimental reactor. There is a 250-megawatt modular prototype in Sevchenko in the Soviet Union which will reach a thousand installed megawatts by 1985.

Within the CTA, this is the concern of the supersecret Advanced Studies Institute, which analyzes fast reactors on three levels: assessment of the cycle (to find out whether the best mechanism is of the thorium-uranium or uranium-plutonium sort), choice of the technology best adapted to the real Brazilian situation, and, finally, plans followed by the building of a low-power unit for tests.

The advantages obtained over the conventional thermic reactors are impressive when the equivalent hydroelectric energy (EHE) indices are compared. This calculation establishes that the country has a hydroelectric potential of 213,000 megawatts, 215,300 tons of uranium ore, and 1,270,000 tons of thorium oxide. Equipment of the type used at Angra-I, for example, only makes it possible to exploit the energy content representing 13 years EHE, because only uranium 235, of which there are only 7 kilograms in each ton, is used. The other 993 kilograms of uranium 238 are simply lost and wasted. Fast reactors, on the contrary, allow almost exhausting the deposits, offering the opportunity to generate 1300 years EHE with uranium, 7,800 years EHE with the thorium plan, while total losses of 15 percent are regarded as normal.

Laser Secret

The mastery of breeder reactor technology does not obviate the need for Brazil to have its procedure for enriching uranium, like Argentina. The national alternative to this is the laser beam. The discovery by the physicist Sergio Porto was announced to the international scientific community on 16 February 1979 at the Brazilian Center for Physics Research, in connection with the production of heavy water. The following day, however, Porto called a press conference in Rio de Janeiro to discuss what he regarded as "the true heart of the question"--the isotopic separation of uranium, making it possible to isolate the fissionable U-235 from the U-238, i.e., enrichment. According to the principle developed by Sergio Porto, this

is done by exposing a cloud of uranium hexafluoride (the gaseous form of the element which solidifies at temperatures below 50 degrees) to a laser beam of carbonic gas. The intense light excites the particles when a frequency of 16,000 micra is reached. This results in the isolation in two groups of the U-235 and the U-238. Both remain thus, separate, after the return to the solid state. However, there are certain difficulties. The oscillations of the laser beam must be strictly in harmony to avoid the collision of atoms and the loss of energy. Sometimes Porto's technique, which leads the atoms toward a magnetically neutral field by means of electrical impulses, fails inexplicably. The laser escalation of enrichment, which is as yet today viable only under laboratory circumstances, and 5 years away from any practical results, is first applied in the vibrational transition stage, followed by electronic transition, and culminating in a reaction in a catalyzer.

Sergio Porto died a few months after exciting the world with his discovery. His work, which was already in the process of being transferred from Campinas State University to the CTA, suffered a brief interruption, but was then continued with the participation of scientists at the USP [Sao Paulo University], the National Nuclear Energy Commission, and the IPEN [Nuclear and Energy Research Institute]. Some of the conclusions, about which secrecy has been maintained, offer new prospects for obtaining heavy water, for nuclear fusion and for an understanding of the behavior of uranium.

The Superaccelerator

The overall success of the project depends, however, on a third component, if it is to contribute to the priority goals of the Advanced Studies Institute of the CTA: that is the linear electron accelerator. According to one of the officers interviewed by O ESTADO and JORNAL DA TARDE, "what we might call the 'trick' where the fast reactor is concerned is understanding neutron behavior. The fact is that this data is not available in the scientific literature, even that reserved for the initiates. And why is this? Because these parameters, stricly speaking, are very important in terms of nuclear weaponry. Naturally none of this is made public. The only way is to learn by doing."

The intention of the IEAv is to design, build and operate a pulsating accelerator, with 180 million electron volts of energy, assimilating know-how and developing a machine to measure neutron shock sections, or other nuclear events. This will be a large mechanism produced jointly with the Physics Institute at the USP. A machine of the same kind being activated at the University of California measures a little less than 1500 meters in length. One of the last points which is still unclear pertains to uranium metallurgical techniques. This is the responsibility of the IPEN, which, through its Project Comet, has already succeeded in providing the material in the form of semi-ingots of simple laminar cut.

The Devastating Effects of an Explosion

A nuclear bomb of 20-30 kilotons would release energy equivalent to the explosion of 20-30,000 tons of TNT. The detonation would occur in classic

fashion, due to the sudden collision of critical fissionable masses, splitting the atoms and initiating a chain reaction. This would occur at an altitude of approximately 500 meters, and the first effect would be the eruption of a ball of fire 400 meters in diameter. A very forceful wind would follow, moving at a speed of 2 kilometers per second, destroying everything in its path. At this point the atomic mushroom would be complete, and the vacuum created in the central column would suck the debris upward in a spiral and would hurl detritus in all directions. The heat, at 9,000 degrees, would pulverize everything over a radius of 3 kilometers in a few seconds. The supersonic shock wave would destroy the more solid structures. Suddenly night would fall, with the sky covered with particles. Then it would rain--radioactive rain.

The technical specifications and the uses of the atomic weapons Brazil might likely have within a period of 10 to 15 years are defined as "general staff tests." In other words, they represent the results of studies by military experts, who in theory are trying to define what configurations would suit the needs of our country's armed forces. Furthermore, all of the analyses, with the exception of those pertaining to the strategic artifacts, give priority to the possibility of conventional use. This is the case for example with the combat missile equivalent to the Soviet SS-1 Scud-B, which launches multiple high explosive antivehicle and antipersonnel projectiles over a distance of 280 kilometers.

The military variation of the huge VLS can also carry a chemical, explosive or fragmentation load for multiple uses of approximately 1,200 kilograms over a distance of 3,000 kilometers. The 155mm gun, which can fire atomic projectiles, is a result of the army's need to have a rapid artillery piece for targets within the 35-kilometer range.

A nuclear submarine of the 4,000-ton displacement class, propelled by a compact reactor, pressurized and refrigerated by water, is clearly established as a goal of the naval ministry in the nuclear sector, although other demands are in abeyance, "in view of the economic situation." This submarine, equipped with torpedoes of the Tigerfish type, as well as missiles for mixed, antinaval and antiaircraft uses, will be able to navigate submerged for up to 30 days.

The military configuration of the VLS is basically like that for civilian use, having four stages and burning solid fuel. The first stage comprises a cluster of four S-40 engines, like the first stage of the preceding rocket, the Sonda-IV. The other three sections will utilize the same propulsion mechanism, built with steel of the 300 ESR type, which is of an extreme hardness so as to resist the high temperatures and the acceleration of 14,400 kilometers per hour. The difference between the two mechanisms lies in the guidance system. While the piloting for the space mission can be effected by secondary injection and stabilized rotation, combat uses require an inertial box and electronic navigation systems.

Potential Confirmed

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 10 Dec 83 p 5

[Text] It was confirmed yesterday in Pirassununga, near Campinas, by Waldyr Vasconcellos, minister-chief of the Armed Forces General Staff (EMFA) that Brazil "is preparing to master nuclear technology completely" and "will be able to produce armaments, including the atomic bomb." Vasconcellos stated that the current stage of studies "is advanced and could lead to the manufacture of an atomic bomb," with the reservation, however, that the goal "is for peaceful purposes." He mentioned the realm of health, and said in conclusion that "an atomic bomb is what people are inferring."

In an interview following the graduation ceremony for officer candidates at the Air Force Academy, which was attended by President Joao Figueiredo, the head of the EMFA said that he could not confirm the schedule for the production of the bomb published by O ESTADO and JORNAL DA TARDE yesterday, but he commented that "Brazil, like any other self-respecting country in the world, must seek very great aid for its development in technology. And one kind of technology is nuclear. No self-respecting country will abandon research in the nuclear energy field." He said that Brazil "can produce an atomic bomb, but it can produce things much more useful to society." Minister of Aeronautics Delio Jardim de Mattos also said that "we are working on nuclear energy, as is the entire world. Brazil is proceeding parallel to international development." On being asked about the bomb specifically, he commented:

"I know nothing about bombs, and I did not speak of bombs." He explained further that he had only read the O ESTADO headline.

Brig Gen Rubem Ludwig, chief of the Military Household of the Presidency, said that he had not yet been informed about the report in O ESTADO, but he stressed that it is difficult to make any predictions about when the country will master this technology. "Laboratory theory is one thing and the industry for commercial production is another," he said, excusing himself for being unable to add details, "since this is a technical problem difficult to explain."

Minister of Navy Maximiano da Fonseca said that "this atomic bomb matter is new to me. There is a clearly defined program for the propulsion of vessels, but I know nothing about any bomb."

National Security

In this connection, military sources in Brasilia which O ESTADO sought out yesterday recalled that "the mastery of nuclear technology, including the conditions for the production of an atomic bomb, are secret matters under the jurisdiction of the National Security Council." Making the point that the author of the article, Roberto Godoy, "is a journalist who merits respect," several military sources nonetheless pointed out that there has been no official acknowledgment of any plan to build the atomic bomb in this country by 1990.

These sources acknowledge, however, that the CTA is pursuing very advanced research and that its scientists "certainly know the techniques for the manufacture of the bomb." However, the country would have no interest in producing it for two reasons: it would encourage nuclear competition in Latin America, and in addition to this, heavy investments would have to be made in a period of such difficulties.

In this connection, a high-ranking air force officer termed it "an exaggeration" to describe the CTA research as primarily for military application. He also stressed that the manufacture of a nuclear bomb by any country is dependent on a "political decision." He recalled the advanced status of Argentina in the research sector which, if accelerated, "could in a short time lead to the bomb, but the Argentine government does not want this--which is good for Brazil."

Our country "is lagging in its research in comparison to the Argentines," and since there is no military threat from its neighbors, Brazil can continue to work without requiring the resources from the more demanding sectors of the nuclear program.

Peaceful Purposes Only

The president of the NUCLEBRAS [Brazilian Nuclear Corporations], Dario Gomes, was unwilling to comment yesterday on the report that Brazil is in a position to manufacture an atomic bomb by 1990, because he is "persuaded that the Brazilian nuclear program is entirely oriented toward peaceful purposes." In his view, the NUCLEBRAS has a program to fulfill, with the construction of eight nuclear plants and the mastery of the fuel cycle, and any proposed use of nuclear energy for military purposes lies outside its jurisdiction.

Dario Gomes explained that within the program for the mastery of the nuclear fuel cycle, the most "sensitive aspect"--reprocessing, the final stage--is still in the design proposal phase. He further said that by the end of 1984, the enterprise will be completing the first uranium enrichment series using centrifugal jets, or jet nozzles, at the Resende Plant, in Rio. This first series is made up of 24 phases by means of which the NUCLEBRAS hopes to obtain uranium 235 enriched to a content of between 0.9 and 1 percent. If this result is in fact achieved, the NUCLEBRAS will be in a position to build a commercial demonstration plant which can begin operation at the end of 1988 or early in 1989, producing uranium 235 enriched to 3 percent.

The president of the NUCLEBRAS challenges those who criticize the purchase by Brazil of a process still being developed and which uses more energy than gaseous diffusion and ultracentrifuging. He noted that on the other hand, it requires a much smaller number of enrichment stages, and therefore is lower in cost than the others.

In the case of Brazil, which has access to electrical energy obtained from water resources, with a possibility of operation outside peak hours, the cost of the energy would not affect the competitive capacity of the process. As the jet nozzle requires the mobilization of comparatively little in the way

of financial resources, it would be the best adapted to conditions in Brazil, he argued.

According to Dario Gomes, other concrete results of the Brazilian nuclear program include the manufacture, also in Resende, of the fuel elements for reloading the Angra-I plant, the production and export of yellow cake, a uranium concentrate, in Pocos de Caldas, the production of nuclear equipment for the NUCLEP [NUCLEBRAS Heavy Equipment, Inc], which is also scheduled to produce a large part of the equipment for Angra II and III, and finally, the production in Brazil of 85 percent of the Angra II project and nearly 95 percent of the Angra III project, on which civil construction work will be begun next year.

1990 Estimate Termed Correct

The prediction that after 1990, Brazil will be in a position to decide whether to build its own atomic bomb is valid, one of the leading authorities in the uses of nuclear energy, the new commander of the CTA, Brig Gen Hugo de Oliveira Piva, said yesterday in Rio. He gave assurance that there is no Brazilian plan to produce an atomic bomb, but he acknowledged that the development of the latest nuclear technology is also guaranteeing the country's progress in connection with uses of atomic technology for weaponry.

He further confirmed that the Advanced Studies Institute of the CTA is developing nuclear technology, but basically nuclear physics. Its studies are designed to contribute to the Brazilian nuclear program, which has internationally recognized peaceful purposes.

He predicted that Brazil would be in a position to produce an atomic bomb within 5 to 7 years after the launching of the project. In his view, Brazil is entitled to master the technology of the atomic bomb, even if it opts not to produce one.

In the opinion of Brigadier General Piva, who will take over command of the CTA on 17 January, the production of an atomic bomb in the future will depend on a high-level domestic political decision.

Brazilian Physics Association

The president of the Brazilian Physics Association, Fernando de Souza Barros, said yesterday that Brazil, like Argentina, will be able to manufacture its atomic bomb in the 1990s, on the basis of its present progress in industrial development and nuclear techology, but he added that the civilian societies in both countries should prevent this armaments race in the Southern Cone, which would have harmful consequences for all Latin American countries.

Souza Barros stressed that the position of the Brazilian Physics Association on the matter is very clear. It demands that all programs of nuclear origin be submitted for study by civilian society, and in particular the national congress. In his view, the whole of Brazilian society should be mobilized to prevent an armaments race in Latin America, and since the decision as to

whether or not to produce an atomic bomb is political in nature, [illegible] through the intervention of the congress and other civilian bodies that such an intent can be blocked.

As to the drafting of an ethical code to block the work of physicists, mathematicians, chemists and other professionals on the production of atomic products, Souza Barros said that the Campinas Charter approved at the meeting of the Brazilian Physics Association warns all physicists to reject employment in any program for the production of nuclear weapons, and he commented that other professionals are aware that the well-being of the nation is not achieved through the production of atomic weapons.

Jose Goldenberg, president of the CESP [Sao Paulo Electric Company] and former director of the Physics Institute at the USP, said in Campinas that the success of the Brazilian nuclear program depends, from his point of view, on the broad participation of the national scientific community. He further expressed the view that fast breeder reactors are "not viable," noting that "the CTA has a short history in the nuclear sector, since the activities of the USP and the CNEN are of longer standing." According to Goldenberg, it is a question of "a long process which can only be successful when based on the participation of the best elements specializing in these areas and available in Brazil."

Itamaraty Palace Position

From the Brasilia branch--"The only thing which can be done is to deny this report. Not just one or even two, but dozens of the Brazilian authorities responsible for our nuclear program have said that Brazil's atomic policy is oriented solely and exclusively toward peaceful ends." This statement was made yesterday by a high source at the Itamaraty Palace, in an analysis of the report to the effect that Brazil is preparing to produce a nuclear bomb, and will be able to achieve total independence in this sector within 7 years.

"Brazil has adopted a clear position in opposition to the armaments race," this diplomat went on to say. "Especially nuclear armaments. More and more, the media are saying that we will have the bomb in the 1990s, that is to say within 15 years. And in 15 years many things can happen. However, what we can state is that in order to produce an atomic bomb, we need, in addition to technology, the political desire. If we do not have the former, we can acquire it. As to the latter, it is hardly likely that we would change position," this source assured us.

In embassy circles, only two sources--representing the United States and France--commented on the report. A source at the American embassy recalled an interview given by then-ambassador Anthony Motley, in connection with a similar report published by the WASHINGTON POST in February of this year.

"As was the case then, nothing leads the American government to believe that Brazil is really producing its bomb. We are persuaded that the Brazilian government has meticulously honored the international safeguard agreements."

A source at the French embassy said that the position of his country is against the entry of new countries into the atomic club. He explained that "in reality, our position has a balance line, for if on the one hand we oppose atomic proliferation, on the other we wonder if it is just for some countries to have a nuclear arsenal while others do not."

Project Termed 'Real Madness'

From the Brasilia branch--Sen Itamar Franco of Minas Gerais (PMDB [Brazilian Democratic Movement Party]), president for 3 years of the Congressional Investigating Commission (CPI) on the Brazilian-German Nuclear Agreement, believes that Brazil should not invest money in the "real madness" which the production of an atomic bomb by 1990 would represent, "solely because Argentina has already mastered this technology."

He believes that it would be hard for the country to establish the conditions enabling it to produce the bomb by that year, unless, as he added, it achieves mastery of the complete nuclear fuel cycle. Again referring to Argentina, he warned that none of this will change the geo-economic picture in the Southern Cone, nor will it make Brazil more democratic.

In Itamar Franco's opinion, the article published by O ESTADO shows that there has been a deviation in the Brazilian nuclear program, "because its goal was always and continues to be the production of atomic energy for peaceful purposes. If the country now turns in the direction of an armaments race, there would seem to be no doubt that there has been a deviation in the programming established for the nuclear sector." As a former president of the CPI on nuclear matters, he recalled that he never encountered any Brazilian interest in producing the bomb. He believes, however, that all that is needed to make the manufacture of these artifacts possible from the technical point of view is mastery of the fuel cycle. "To achieve this, however, Brazil would not have needed to contract for the building of eight plants."

Agreement With Germany Unchanged

Report from Bonn by Assis Mendonca--No official source in Bonn would make any commentary about the possibility of Brazil's beginning construction of an atomic bomb as of 1990. The Ministry of Research and Technology and the official in charge of cooperation between Brazil and the FRG in the scientific (including nuclear) sector, and a high official in the government establishment refused to comment on the matter, saying that they were unaware of any reports, official or otherwise, about such plans. The ministerial official said that "I can only tell you that the cooperation on which the FRG and Brazil have agreed pertains exclusively to the peaceful use of nuclear energy. This is the way the agreement reads and we here have never had any doubt about the fulfillment of the contract by the two parties, since the beginning of joint work in 1975. There is no reason to doubt the fidelity of either party to the contract." According to the ministerial source, the German-Brazilian Technical-Scientific Cooperation Commission met in Brasilia on 8 and 9 November last and saw no indication that the Brazilian party had

ceased to keep the promise made to use nuclear energy exclusively for peaceful purposes.

In the view of the KWU, the main supplier of equipment for the construction of the nuclear reactors involved in the Brazilian-German agreement, it is practically impossible to manufacture an atomic bomb on the basis of the know-how available to commerical atomic plants. According to an enterprise spokesman, any possible Brazilian decision to produce an atomic bomb could have nothing to do with the Brazilian-German agreement, because "the worst and the slowest path a country could choose" for the development of nuclear weapons would, in his view, be the production of plutonium by commercial light water reactors.

The KWU source further that there is no joint work or cooperation on the part of the enterprise with any Brazilian military body, and that no components or other equipment items have ever been supplied to the CTA in Sao Jose dos Campos, or to any other research center affiliated with the Brazilian armed forces. The work done and the supplies provided by the KWU are limited to the sectors, covered by the Brazilian-German agreement, through the NUCLEBRAS and its subsidiaries.

The statement by the KWU official to the effect that the use of commercial plants for the manufacture of atomic bombs would be the most difficult and time-consuming path was also indirectly confirmed by the International Atomic Agency (IAEA) in Vienna. This organization is entrusted with the international supervision of nuclear installations, and has a contract with the Brazilian government for the supervision of all the atomic equipment in the country, including commercial and research reactors and similar installations. Such a contract with the IAEA was one of the prerequisites for the signing of the cooperation agreement with the FRG. Thus the diversion of radioactive material for the secret construction of an atomic bomb is practically impossible, without the agency in Vienna becoming aware of the fact.

But, spokesman Hans Meier told O ESTADO yesterday, the IAEA "is not a secret service." In other words, this organization, affiliated with the United Nations, does not investigate possible parallel violations of international radioactive materials control. It merely verifies the source and the use of such materials at the nuclear facilities to which governments give it access. In Brazil, for example, the agency is currently checking on the Agra I plant, three research reactors (in Sao Paulo, Rio and Belo Horizonte) and a similar unit located in Resende, in the state of Rio. The other installations for which the Brazilian-German agreement provides are not as yet operational, and therefore they cannot yet be checked. If the Brazilian or Argentine government, or any other, were to build secret installations with its own resources for the production of the plutonium needed to manufacture the bomb, the IAEA would not have any way to know of it, much less prevent it.

Industry Ready To Cooperate

From the Porto Alegre branch--The managers of Taurus Foundries, which are now supplying a series of war equipment items to the armed forces, and of Amadeo

Rossi Metallurgy, a former supplier, said yesterday that they are in a position to participate in the future in the Brazilian nuclear program through the manufacture of specially ordered components.

The vice president of Taurus Foundries, Luis Fernando Costa Estima, stressed that the philosophy of the enterprise "is to develop its own technology through its own industrial park or through technological development centers, such as to make it capable of producing what the Brazilian armed forces wants to begin to use." And he added that "we are today producing a range of light weapons, such as revolvers, pistols, light machine guns, etc., and we will be available, as we always have been, to the armed forces if it serves the interests of both parties to develop some project in this sector (nuclear). Taurus is an enterprise which has the capacity to produce what is necessary."

However, Costa Estima said that he is not in a position for the moment to "identify precisely and in what area the enterprise could participate in such a project." As to the desirability of a national effort to develop nuclear technology, the vice-president of Taurus Foundries commented that "Brazil is an emerging power, and as such it needs to be in the technological lead, using the latest developments in the world in order to acquire the capacity for membership in the group of developed countries."

Apart from maintaining the balance of forces with Argentina, mastery of nuclear technology by Brazil is a valid need, Costa Estima went on to say, "because it makes the country able to develop new energy sources and work on projects with extremely sophisticated technology, since these projects yield development in the widest variety of sectors as a byproduct." With 2,000 employees, two plants in Porto Alegre, one in Sao Leopoldo, Rio Grande do Sul, one in Sao Paulo and another in Miami in the United States, Taurus is one of the largest present suppliers of light equipment to the armed forces.

The president of Amadeo Rossi Metallurgy, Milton Rossi, in turn, commented that although he personally has very little knowledge of the nuclear sector, the enterprise, as a former armed forces supplier, has the capacity at its Sao Leopoldo Plant to produce components for rockets in the future. "We have the technology for high alloy steel smelting for rockets and other components. We can produce highly specialized steel, resistant to tremendous temperatures, for rockets of any kind."

Jair Soares (PDS [Social Democratic Party]), governor of Rio Grande do Sul, showed caution in commenting on the reports about the Brazilian nuclear project. In an interview prior to a luncheon meeting sponsored by the Brazilian Sales Managers Association, which he attended, he stated: "This is a national security area. I am not in a position to express a view in this connection. I do not know at what stage these experiments are. For the component sector, naturally, it is the military which must deal with these matters and announce to the nation, if appropriate, the reasons. I believe that Brazil, as a great power, cannot fail to participate in scientific and technological development. Now on problems of national security, I really do not feel that I am in a position to express an opinion."

5157
CSO: 5100/2044

CALS CITES MANUFACTURE OF BOMB AS PRIORITY, CLARIFICATION

Policy Shift Explained

Brasilia CORREIO BRAZILIENSE in Portuguese 14 Dec 83 p 6

[Text] The Brazilian nuclear program (which absorbed $4 billion during the past 10 years, for two plants that are still in the foundation stage and another that continues to be at a standstill in Angra dos Reis) now has new features, the third since President Figueiredo took over the government.

Yesterday, in Rio, the minister of mines and energy, Cesar Cals, remarked that the government's current priority is the "conquest of the atom," in other words, the bomb, but for "peaceful purposes," as the minister commented.

Argentina in the Lead

This sudden change of tone in the Brazilian nuclear program is occurring a few days after the Argentine authorities stated that they now dominate uranium enrichment, the most sensitive part of the nuclear fuel cycle, gained with the aid of foreign technology from Canada developed domestically.

According to Cals, Brazil is already developing its technology in search of the atom's conquest, at ITA [Technical Institute of Aeronautics], in Sao Jose dos Campos, research that has now been overtly undertaken since the statement from the Argentine authorities. In Cals' opinion, the nuclear powerplants are no longer as important as they were previously, for certain reasons.

He said that the first of these is the energy surplus; another is the economic recession; and the most serious one is the lack of money. All these arguments had already been put forth by Brazilian scientists and economists 3 years ago, but they were flatly denied by the Brazilian Government.

The minister of mines and energy said that, at ITA, in Sao Jose dos Campos, Brazilian scientists are now working on atomic research, adopting a completely "native" technology. He now admits that this project was established at the beginning of the Figueiredo government as a "priority," but the development of the research has not been admitted publicly until the present.

Cals said: "We have more of a chance to develop the complete fuel cycle, because the cost is low in comparison with what is being spent on the nuclear plants."

The minister could not explain how Brazil intends to acquire the independent cycle technology from Germany, because, based on the agreement signed between the two countries in 1975, the German Government will make the transfer of technology only if the Brazilian Government will purchase at least the four plants in the initial contract.

Cals only noted that the contracts between the two governments are being "negotiated with complete understanding in advance between the parties; because they know that Brazil lacks the money for dealing with that program as it had been up until then."

Iguape Not Until 1987

The first signs that the Brazilian Government intends to step up Brazil's nuclear program preeminently are the extensions in the periods for construction of the plants purchased from Germany. For example, the Iguape nuclear powerplant in Sao Paulo now has a new deadline: 1987, with a 2-year lag in the last deadline and a 5-year lag in the original deadline. Based on the plans of the former president of NUCLEBRAS [Brazilian Nuclear Corporations, Inc], Paulo Nogueira Batista, Brazil should now have eight nuclear powerplants, something which is still very far removed from occurring.

Of the $4 billion invested, the Anga I plant alone, purchased from Westinghouse of the United States, has already consumed $1.6 billion. When it was projected in 1972, plans called for an expenditure by 1977, the final deadline for completion, of $335 million. Hence, according to the current count, the installed kilowatt in the Angra I plant now stands at $2,200; nearly double that of the Itaipu plant, which will generate 12,600 megawatts, in contrast to the 626 megawatts from the Angra dos Reis nuclear plant.

Oil Forecast

The minister of mines and energy, who departed for Angola at 1900 hours yesterday, also discussed the prospects for oil imports in 1984. He claimed that Brazil will have to import only 450,000 barrels per day of oil in 1984, reducing the purchases by 100,000 barrels and saving nearly $1 billion in foreign exchange. So, the imports should decline in cost from the present $6 billion to $5 billion in 1984.

This prediction should be borne out because, starting next year, domestic oil production is expected to rise from the current 400,000 barrels per day, in addition to which alcohol production and the consumption of other types of energy to replace oil will increase.

Misinterpretation Claimed

Brasilia CORREIO BRAZILIENSE in Portuguese 15 Dec 83 p 12

[Text] Yesterday, the Ministry of Mines and Energy disseminated an official note disputing the statement that "Brazil is attempting to evade the peaceful

uses of nuclear technology," but never declared that the Brazilian bomb is not being developed.

The note asserts that the ministry regrets the interpretation of [illegible] carried by CORREIO BRAZILIENSE, inasmuch as Minister Cesar Cals, in with the press in Rio de Janeiro, cited the priority given to [illegible] of the technology for the entire fuel cycle, as was widely reported other news media.

According to the note, in view of the present economic problems, nuclear program has to be revised, with changes in timetables and ment of priorities; but the original, permanent goals involve [illegible] of nuclear technology for peaceful purposes, and are not limited to the generation of power, but also have implications for medicine, and bromatology.

The note concludes by stating: "Any readings, deductions or inferences to the conclusion that Brazil is attempting to evade the peaceful [illegible] nuclear technology do not have the slightest grounds and are devoid of substance."

Note to the Press

In view of the report on the subject carried by CORREIO BRAZILIENSE the Brazilian nuclear program, the Ministry of Mines and Energy has clarified the following points:

The Brazilian nuclear program is an integral part of the Permanent National Development.

Adhering to the national reality, the nuclear program corresponds to conditions prevailing in the country.

In view of the present economic vicissitudes, the program must be revised with changes in timetable and realignment of priorities.

These changes are aimed at providing the conditions for faithful [illegible] with agreements and treaties signed by Brazil and at maintaining [illegible] lity and goals of the program.

The original, permanent goals involve complete mastery of nuclear f [illegible] aceful purposes, wherein the generation of electric power is [illegible] of the requirements forecast for the near future.

The peaceful use of nuclear technology is not limited exclusively to generation of power, because the projects in the areas of medicine, agriculture and bromatology currently under way in the country, executed by NUCLEBRAS and CNEN [National Commission for Nuclear Energy], have grown more than sufficiently.

Any readings, deductions or inferences leading to the conclusion that Brazil is attempting to evade the peaceful uses of nuclear technology do not have the slightest grounds and are devoid of any substance.

Therefore, the Ministry of Mines and Energy expresses regret at the interpretation of the matter carried by CORREIO BRAZILIENSE, inasmuch as Minister Cesar Cals, during a meeting with the press in the city of Rio de Janeiro, cited the priority given to complete master of the technology for the entire fuel cycle, as was widely reported by the other news media represented on that occasion, in addition to giving a reminder that the minister of mines and energy, in interviews with the press, has repeatedly reiterated the exclusively peaceful use of the Brazilian nuclear program.

2909
CSO: 5100/2050

OFFICIALS COMMENT ON GOVERNMENT NUCLEAR PROGRAM

IAE Head on Weapons Capability

PY162155 Rio de Janeiro JORNAL DO BRASIL in Portuguese 14 Dec 83 p 18

[Text] Sao Paulo -- The present IAE (Space Activities Institute) director, Major General [illegible], who on 17 January will assume the direction of the San Jose dos Campos Space Technical Center [CTA], noted yesterday that Brazil is capable of producing a nuclear bomb within either 5 or 10 years. The San Jose dos Campos Space Technical Center is the most advanced center of high technology studies for Brazilian war and space programs.

Maj Gen Piva added that Brazil is acquiring experience through its own technological and scientific development. Our scientific community achieved some important things and all this has contributed to training in manufacturing heavy weapons. Brazil is certainly able to build an atom bomb, but not today. However, if the Brazilian Government makes this decision today, we would be able to manufacture it. I cannot say how long it will take, but I believe we can do it in 5 or 10 years. Of course, this will demand the joint work of all our scientists who are involved in other activities.

The IAE is one of the two institutes that are subordinated to the CTA, and among others, it carries out studies on rockets and sophisticated weapons. It was the IAE which planned and developed the Brazilian SONDA rockets which are still being used for research in the stratosphere and launched from the Barreira do Inferno station in Natal, Rio Grande do Norte.

General Hugo Piva noted that Brazil does not intend to build a nuclear bomb. He added that "our research is aimed at improving our living conditions and at achieving technological progress so as to achieve the well-being, development, and integration of the country." He noted that as far as he knows "we are not studying the possibility" of building nuclear weapons. He said: "Of course we are aware of the issue and we have even studied the situation, although superficially, as a possible alternative in case there is a political decision in this regard.

Piva noted that, if there is a political decision in this regard, Brazil may be able to make ballistic missiles. But he noted that "we are not heading in this direction." He said "our space program is aimed at launching observation satellites for meteorology, communication, and data collecting purposes with the objective of improving the well-being of the people. It is obvious that if we have a satellite launcher rocket it is relatively easy, although not as easy as some may think, to transform this launcher rocket into a ballistic missile. But achieving this is a long way ahead. However, we will be in a position to achieve it. Piva said that the development of this highly sophisticated technology "will make us familiar with those techniques that are also used to manufacture weapons."

The future CTA director added that the Brazilian nuclear program aims to nationalize the sector, that is that all equipment is manufactured in Brazil. He said: As a result of this we are getting more experience in this field.

Itamaraty Reasserts Program Peaceful

PY171640 Sao Paulo O ESTADO DE SAO PAULO in Portuguese 15 Dec 83 p 6

[Text] Analyzing the declaration by Mines and Energy Minister Cesar Cals on changes in the course of the Brazilian nuclear policy, Itamaraty spokesman Bernardo Pericas said yesterday that "having mastery over the complete nuclear fuel cycle is being confused with manufacturing an atomic bomb."

After recalling that Minister Cesar Cals had said that Brazil has decided to make an all-out effort to master the nuclear cycle, the Itamaraty spokesman denied that efforts will be made to manufacture nuclear devices by saying that there is no change to that effect in Brazil's nuclear policy, because the two things are completely different. "Mastery over the complete nuclear fuel cycle is one thing, and a political decision to manufacture an atomic bomb is another thing.

Admitting that because of economic problems there is a slow-down in the Brazilian nuclear program as far as the construction of nuclear plants is concerned, Pericas added: "Brazil has adopted a policy of peaceful utilization of nuclear energy. There is no other priority because the Brazilian Government has no intention of manufacturing a bomb. Although mastery over the nuclear cycle technology is a prerequisite for manufacturing the bomb, that does not necessarily mean that the bomb will be manufactured. Manufacture of the bomb calls for a political decision, and Brazil's decision is not to build the bomb."

Pericas recalled that the manufacture of the atomic bomb would depend on a change in Brazil's nuclear strategic policy, adding that this had already been made clear by [former NUCLEBRAS president] Paulo Nogueira Batista when he analyzed this question in Geneva.

Pericas said: "Brazil is bound by the commitment it assumed upon signing the Tlatelolco Treaty, and it ratified the utilization of nuclear energy for peaceful ends exclusively."

At the FRG Embassy which, since the FRG is Brazil's partner in the nuclear program, follows the development of the Brazilian nuclear program, Minister Gunter Shutz said that there is no indication that Brazil is interested in nuclear technology in order to manufacture nuclear devices. He then cited declarations by NUCLEBRAS President Mario Gomez that the construction of the nuclear plant Angra 1 and Angra 2 will be carried out, adding that Minister Cals himself had said that the construction of the nuclear plants Iguape 1 and Iguape 2 will get underway in 1986 or 1987.

Discussing the question of whether the Brazilian nuclear program is lagging behind the Argentine program, the FRG spokesman said that the light water-enriched uranium nuclear plants which Brazil is building are more economical and modern than the Argentine plant Atucha 1. He recalled that the uranium enrichment process which Argentina had announced relies on gaseous diffusion, which is a less advanced method. According to Shutz, the gaseous diffusion methods has been in use in France, the United States and the USSR for about 40 years, and there are much more advanced methods for enriching uranium today, such as the jet-nozzle method which Brazil has adopted.

The FRG spokesman also said that reports about an arms race in Latin America is nothing but speculation, and that the FRG Government is convinced that the new Argentine Government will continue the nuclear program along peaceful lines. He then added that the FRG is today in the position to build an atomic bomb but that it never will.

In turn, the Mines and Energy Ministry released a note yesterday deploring the interpretation given by a Brasilia newspaper to Minister Cesar Cals' declaration in Rio de Janeiro. The note says that the report that Brazil intends to change the peaceful character of its nuclear program is baseless. That newspaper report said that for the first time Minister Cals had admitted that the manufacture of an atomic bomb is a government priority.

According to the advisor's office of the Mines and Energy minister, the minister had only referred to giving priority to the complete nuclear fuel cycle, [illegible] building of nuclear plants. The note explains that the change had been made for economic reasons, rearranging timetables and priorities, but that "the original and abiding objectives" of the Brazilian nuclear program continue unchanged.

The note concludes by stating that "any inference leading to the conclusion that Brazil intends to depart from the peaceful uses of nuclear technology has no basis whatsoever and has no credibility."

Scientists Qualify Weapons Denials

PY171615 Sao Paulo O ESTADO DE SAO PAULO in Portuguese 16 Dec 83 p 5

[Text] The Mines and Energy Ministry's denial and Itamaraty's explanatory note, which were made public on Wednesday [14 December], that Brazil does not intend to manufacture an atomic bomb "should only be understood to apply in the jurisdiction of the ministries and in the context of the Brazilian-FRG nuclear agreement." This is the opinion of scientists who are involved in nuclear research, not subject to safeguards, which is being conducted in the Aerospace Technology Center, the Institute for Nuclear and Energy Research, and other research institutions involved in the project for "acquiring independent technology in the strategic area."

According to the experts, "there is no intention of building military nuclear devices at this time, and probably that decision will not be made, but it would be naive to believe that a decision made by the current government could be binding on Brazilian governments in the 1990's when the geopolitical picture will certainly be different, and the national sovereignty will have to be discussed in the light of the situation in the next decade." In the opinion of high-ranking military researchers, "diplomats are seized by some kind of shyness which keeps them from admitting that in the medium-term Brazil might decide to use nuclear technology in any of the alternatives inherent in the possession of the complete nuclear fuel cycle." Still according to the same source, "what all the research institutions are doing at this time is trying to gain knowledge in the nuclear field, so that the country can use its natural resources more fully, as is the case with the thorium fast reactor, and to do so without being dependent on any other country."

This question has been broadly debated after the O ESTADO DE SAO PAULO [on 9 December] and the JORNAL DA TARDE published a report on this matter. The experts believe that these articles will produce "the positive result of finally disclosing to the nation the real objectives of the nuclear projects and investigations being carried on outside NUCLEBRAS facilities, and which are therefore secret and suspicious."

CSO: 5100/2047

REFUSAL TO SIGN NPT REITERATED TO IAEA

PY151455 Buenos Aires TELAM in Spanish 2015 GMT 13 Dec 83

[Text] Rio de Janeiro, 13 Dec (TELAM) -- The International Atomic Energy Agency (IAEA) has received in its main offices in Vienna another Brazilian Government refusal to sign the "Nuclear Nonproliferation Treaty."

It has been that learned during the visit IAEA Director General Hans Blix made to Argentina and Brazil, Foreign Minister Ramiro Saraiva Guerreiro conveyed to Blix the Brazilian Government's refusal to sign the treaty.

Brazil is developing nuclear technology for the sole purpose of producing electricity and developing the related scientific field in compliance with the provisions of the charter and the safeguards of the IAEA, of which Brazil is a member.

Brazil maintained that the Nuclear Nonproliferation Treaty must be signed by countries that have stockpiles of nuclear bombs and missiles, the proliferation of which is specifically banned by the treaty.

Brazil noted that not all the countries "that are filled to the brim with megatons, such as France, India, and the PRC, are signatories of the treaty."

It added that "the countries that underscore the importance of the treaty are precisely those which proliferate nuclear arms, such as the USSR, the United States, and Great Britain."

Brazil conveyed to the IAEA its opinion that "prior to the prevention of an arms race by disarmed countries, it would be necessary to disarm those countries that are already armed."

The Brazilians did not fail to recognize that the IAEA's activities are restricted because it does not have access to just any official facility included or not under the safeguard agreements.

"Though unbelievable, the IAEA cannot carry out its activities in any country without a 30-day advance notice. This, in fact, allows for the covering up of any work in violation of the treaty," it was noted by Brazilian diplomatic sources.

CSO: 5100/2042

BID TO SIGN NONPROLIFERATION TREATY REJECTED

PY0211135 Sao Paulo FOLHA DE SAO PAULO in Portuguese 30 Nov 83 p 4

[Excerpt] The government yesterday rejected joining the Nuclear Nonproliferation Treaty [NPT], and told Hans Blix, director of the International Atomic Energy Agency (IAEA), that the Brazilian nuclear program is intended for peaceful purposes and that this has been assured by Brazil's adherence to the Tlaltelolco Treaty, which binds Latin American countries to a nuclear-free zone.

The IAEA director spent the day yesterday in Brasilia trying to persuade President Joao Figueiredo and Foreign Minister Ramiro Saraiva Guerreiro of the advantages of Brazil's participation in the NPT in order to strengthen the international safeguards system as the only capable means of preventing the proliferation of atomic weapons. According to diplomatic sources, Blix pleaded the case diplomatically, stressing at all times that adhering to the NPT is "Brazil's sovereign decision."

CSO: 5100/2035

MINISTER ON LASER URANIUM ENRICHMENT TECHNIQUE

PY051248 Rio de Janeiro O GLOBO in Portuguese 3 Dec 83 p 18

[Text] Brazil is developing the technique to produce enriched uranium with laser rays, but work has slowed since scientist Sergio Porto from Campinas University died. Mines and Energy Minister Cesar Cals yesterday stated that the same type of research is being carried out at the Institute for Nuclear and Energy Research [IPEN] and at the Aerospace Technology Center [CTA].

[Sao Paulo Radio Bandeirantes Network in Portuguese at 1000 GMT on 5 December 1983 reported: "Professor (Rogerio Cersa de Terqueira Leite), head of the physics department of Campinas University, has denied statements by Mines Minister Cesar Cals that the university is developing a technique to enrich uranium with laser rays."]

CSO: 5100/2035

NUCLEAR ENERGY USE BEGINNING IN 1990'S FORESEEN

PY201253 Madrid EFE in Spanish 0125 GMT 19 Dec 83

[Excerpt] Santiago, 18 Dec (EFE) -- Chile will not begin to look into the possibilities of using nuclear energy until 1985. In the meanwhile, its two atomic reactors will be devoted to research work.

Brigadier General Juan Mir, executive director of the Chilean Nuclear Energy Commission, affirmed in an interview carried by TERCERA DE LA HORA today that the studies envisioning the building of a power reactor were shelved in 1979 for economic reasons, because more economical alternatives for the production of energy were available at that time.

He then added that "the nuclear alternative will be reviewed in 1985, because it is probable this method of generating energy will be economically feasible in the 1990's."

The Chilean Nuclear Energy Commission is at present preparing adequate legislation for the country's nuclear development, while trying to master basic nuclear technology, and carrying out applied science projects in agriculture, medicine, and industry.

CSO: 5100/2048

ENERGY MINISTER COMMENTS ON NUCLEAR DEVELOPMENT, URAMEX

Mexico City EXCELSIOR in Spanish 2 Nov 83 pp 1-A, 11-A

[From second part of two-part series on Mexican energy sector]

[Article by Carlos Velasco M.]

[Excerpt] Secretary of Energy, Mines, and Parastate Industry Francisco Labastida Ochoa announced that last year "the federal government deficit was more than 17 percent of the GDP and that, in 1983, it will drop to almost half or less"; he said that "there is no political position behind the labor case involving Uranio Mexicano" and made it clear that, as of now, "Mexico is moving in the right direction, in spite of the serious limitations existing at this time."

The official explained that Uramex [Mexican Uranium] "is a particularly complex problem where, on top of circumstantial problems involved in the use of and demand for uranium, we also have basic problems relating to the enterprise's productivity."

We in the Secretariat of Energy, Mines, and Parastate Industry are convinced that uranium is a great source of energy wealth and in this sense, uranium is a priority matter in Mexico, the official pointed out and added:

"This is why we must exploit it rationally and productively because it is a viable source of energy diversification for the country in medium-range terms."

He indicated that the domestic demand "is the thing that governs the exploitation of uranium and we only produce it in its simplest forms because its enrichment requires very large quantities of this mineral so that its exploitation may be economical."

He also reported that the demand for uranium in Mexico is very low due to the fact that the first unit of the Laguna Verde plant, which will become operational in 1986, will require 100 tons of uranium per year. There will be fluctuations in this demand but it will be generally on this order of magnitude.

In announcing that the second unit of the Laguna Verde plant might possibly become operational in 1988, Labastida Ochoa rejected the idea that we could export uranium at this time.

we cannot sell it abroad because, on the one hand, there are restrictions and limitations in the corresponding law. Besides, our production cost, compared to the international cost, is double the latter and, from the viewpoint of the country's wealth and the country's uranium deposits, it is not a good idea for the country to export uranium.

And he emphasized: "It is not a good idea for us to export it because the costs are higher than the international price."

In view of these conditions, he added, what we have to do is continue with uranium prospecting and exploration activities in order to determine the resources we do have in Mexico in this respect. And then we must set up the mines, the milling and processing plants so that we may get good production costs and thus make sure that uranium exploration will not be an economic burden to the country but, on the contrary, will be a source of energy diversification for the country under economical conditions.

Labor Problem

He talked about the labor problem which persists in the Uranio Mexicano enterprise and said:

"This enterprise--where there has been a problem of time, demand quantity, and adaptation in terms of what we are doing regarding the magnitudes which will be required in the country--is going through a conflict which meant that URAMEX has come to a halt; an attempt has been made to provide political interpretations for this conflict although this does not apply."

Labastida Ochoa said URAMEX has had problems in its development this year and warned that the labor union in URAMEX "normally operates in the other federal government agency (ININ [National Institute for Nuclear Research]) where the problems we have had in URAMEX did not come up. This demonstrates that this does not involve an attack on a union. We respect the political and ideological position."

"We only ask," the man in charge of SEMIP [Secretariat of Energy, Mines, and Parastate Industry] continued, "that they adequately comply with what they are supposed to do in an enterprise, in other words, work, and moreover, work in productive terms."

He then repeated that "there are no political positions behind this problem" and he denied that there is the remotest possibility that uranium might be exploited in Mexico by foreign companies.

"That is completely false," the official said.

"The exploitation of uranium is an activity reserved for the nation in the Magna Carta. It is considered a strategic activity and is so designated in the Constitution. We will not yield on that point," Labastida Ochoa affirmed.

exploration will continue to be an activity reserved
we are trying to do is to make sure that this exploi-
benefit of Mexico and that this will be handled in such
will not signify a burden to Mexico but rather a contribution
growth," he pointed out.

NUCLEAR DEVELOPMENT IN AFRICAN ARAB COUNTRIES DISCUSSED

Paris AFRIQUE DEFENSE in French No 68, Nov 83 pp 41-54

[Article: "Nuclear Proliferation in Africa"]

[Excerpts] The power of the atomic weapon, which is now a thermonuclear weapon, is such that it could destroy part of the human race. Concentrated as it is in the hands of a few states, it is in their eyes, and especially in the eyes of the states who do not have it, both the symbol of total war power and the symbol of the power that will prevent any direct war engagement.

Whereas most states, especially the richest, were directly or indirectly involved in the last two World Wars, a number of countries have now become nearly inviolable military sanctuaries. On the other hand, nothing has changed for the others. They are threatened both by their own quarrels and by the battles which sanctuary-states may fight on their territories, directly or through third parties, and with impunity.

A new class of states has therefore emerged: states which can dominate the others because they possess a nuclear arsenal.

The age of nuclear power has come, and the proliferation of technologies will provide for constant change in the international strategic environment.

Now, the non-proliferation treaty (NPT), the only treaty restricting the proliferation of nuclear weapons, is inadequate and cannot control the states' desire for equality and prestige. In addition, its effectiveness is only relative, as states may sign it without signing the International Atomic Energy Agency (IAEA) guarantee agreements which provide for regular inspections of the nuclear facilities of signatory states. These inspections are intended to check that nuclear facilities designed to

> produce little-enriched fuel are not actually producing fuel that could be used for military purposes. But, at present, there is no international regulation prohibiting the construction of nuclear infrastructures for the direct production of military-grade fuel...
>
> As a result, this climate of grandeur, the facilities offered have not failed to attract the attention of developing Africa, especially since the Republic of South Africa has acquired nuclear capabilities.

The form that proliferation could take in Africa may be understood in the context of worldwide proliferation. At a time when 562 experimental or industrial reactors are distributed in 33 countries, states with high political ambitions have a chance of joining in the race, just as much for the symbol it represents as to gain an advantage in the competition that opposes them to other states in their region.

A look at the list of candidates who would enter the nuclear power club might make us think that only the more technologically developed countries would join the nuclear arms race. Yet, this trend has shifted in the past seven years. Technology transfers have seemed to increase, so that less technologically developed countries can now trade either their raw materials or their geostrategic position for the much-desired nuclear knowhow.

Today, 11 states on the African continent are interested in various stages of nuclear technology, from the mere experimental reactor for civilian purposes to the full-fledged military arsenal; some proclaim their decision to use nuclear energy for civilian purposes only, others more or less openly display their determination to use nuclear technology for military purposes. In addition to these 11 countries, there is 1 which has no nuclear ambitions but occupies an important position because it possesses uranium ore: Niger.

Despite these marked determinations, it is a good idea to consider these 11 states' overall ability to become nuclear military powers.

Thirty-seven years after Hiroshima and Nagasaki were devastated by an atom bomb and a new era began, the general credibility conditions for nuclear dissuasion have become clear enough. However, reality is excessively complex and it may be a simplification to attempt to define criteria that would seem to determine whether a country can effectively dissuade its potential aggressors or victims. In our opinion, these criteria may be considered to fall into two categories: conditions internal to the country, and conditions external to the country.

The conditions internal to the country are many. First, the region considered must obviously be a state consisting of a territory, a population and a governing authority (in our analysis, we shall not consider nuclear terrorism by individuals or private groups). Now, the governing authority, which is the state, must have a highly centralized decision-making power. Second, the state must include an administrative and military hierarchy that is structured and, above all, will obey any orders. Third, the country must possess a wealth of scientific, intellectual and military personnel capable of defining the doctrine of use or non-use

of their state's nuclear weapons. This of course implies that a gigantic educational program involving all population levels is carried out to select an elite. The fourth condition is still more essential than the first one. It is that the state must be in a position to pursue unrelentingly the development and modernization of its arsenal. To do this, it must not only have political determination, but it must also fulfill three additional conditions: it must possess uranium, it must possess experimental grounds, and finally it must be able to display credible results in the thermonuclear field.

The internal condition then becomes one with the condition external to the country, and it is obviously the reason, the cause of nuclear dissuasion: the condition is that someone must be perceived as an aggressor or as a victim. It may be a nuclear state or a non-nuclear state. It is difficult to break down this condition into subconditions, for it is a relatively monolithic condition, even though the perception of the enemy must always be qualified.

Finally, these two categories of conditions will acquire a meaning only if the state is determined to become a nuclear power.

Now that the conditions have been enumerated, one question naturally comes to mind. These conditions may be valid for highly developed countries, but do they apply to politically, economically and materially developing states?

We must provide an unequivocal answer to this question: men do not apply their own logic to nuclear weapons. Quite to the contrary, nuclear weapons possess a logic of their own, and states which ambition to become nuclear powers must adopt it.

It has become a truism to speak of fundamental differences when comparing the new weapons with the old ones. Yet, although all recognize that they have little in common, very few accept all the implications of the strategic and political upheaval caused by the advent of nuclear weapons. If there is one domain in which reasoning by analogy with the past is irrelevant, it is this one. Yet, in most cases, when we discuss nuclear issues and their impact on the international situation, we do so with reference to the political and military laws of the previous era, when the new weapons did not exist.

The African continent as a whole includes 11 states with nuclear ambitions: Algeria, Egypt, Gabon, Ghana, Kenya, Libya, Morocco, Nigeria, the Republic of South Africa, Tunisia and Zaire.

We shall also consider the situation of Niger.

Let us now see to what extent each of these countries fulfills the conditions defined above.

Algeria

Although it became independent only in 1962, Algeria nevertheless has an ancient political tradition. Indeed, like all Islamic countries, it derived its national tradition from the religion of the Prophet, which imposes a strict hierarchy that

all the faithful must respect. At any rate, from Ben Bella to Boumediene and Chadli Bendjedid, the tradition of a state in which decision-making is centralized has been preserved. The same is true of the tradition of the administrative structure, which was here reinforced by the French. Higher education is developed to a relatively large extent. Already in 1958, at the time of the Constantine Plan initiated by General de Gaulle to industrialize Algeria, Professor Lapierre had created in Algeria a Science and Technology Institute with which the French Atomic Energy Commission has always cooperated. This institute now has a staff of 1,401, including 200 research scientists. In addition, many students of all disciplines are sent to foreign higher-education institutions.

When it comes to financial wealth, Algeria's position is not ideal, although it is relatively favorable. We should note that the present nuclear powers, those with the higher gross national product, have for many years devoted over 3 percent per year in the case of France, and up to 14 percent per year in the case of the USSR, to their defense effort. It is estimated that to acquire a credible nuclear arsenal France has spent 221,982.6 million constant francs, or 44,396.52 million constant dollars (exclusive of other defense expenditures), i.e. an annual average of 2,219,826,000 constant dollars.

In 1980, France, an average nuclear power, acknowledged that it had spent a total of 16,461 million francs for its strategic nuclear force and its tactical nuclear arsenal; this included 6,626 million for design and development, 641 million for infrastructures, 4,247 million for production, 3,154 million for operations, 774 million for current expenditures, and 1,531 million for payroll and social benefits.

Algeria's gross national product rose after 1970, when it amounted to 3,470.7 million dollars. It amounted to 13.68 billion dollars in 1975 and to 36,324 million in 1982, i.e. a tenfold increase in 13 years. In 1970, Algeria devoted 170 million dollars and 4 percent of its gross national product to defense expenditures; in 1975, 221 million and 1.8 percent; and in 1982, 914 million and 2.5 percent of its gross national product. Despite this considerable and commendable improvement, the country is certainly far from being in a position to imitate France in spending 2 billion dollars a year just on nuclear weapons! As a result, all Algeria can do until its economy improves is to restrict itself to civilian nuclear energy and to replace little by little its present energy sources.

The condition of unrelenting future development appears to be met to the extent that political determination will follow in this undertaking. In addition, the three subconditions--uranium ore, testing grounds and credible results--are easily fulfilled in this case. Algeria does not possess uranium ore. There is no lack of it in West Sahara, it is said. Obviously, this is one among many other reasons for which Algeria is relentlessly supporting the POLISARIO front in conquering this territory left vacant by Spanish decolonization. The problem of testing grounds does not arise in this case, as a testing range and its infrastructure have already been installed by the French in the Sahara Desert. Credible results cannot be examined yet, as the nuclear project is only two years' old. There remains therefore the question of finding out who is Algeria's enemy. Since 1962, Algeria has has a strong nonaligned policy with respect to the two superpowers, with a slight preference for the socialist bloc, although its

the United States are not bad at
Actually, antagonism to
Spain left West Sahara. The
struggle, and no solution appears to
various states and international
a tentative solution may have been
in Unity. However, the two countries
troops so often that a conflict is
long run, this factor could cause
nuclear powers, as both feel their
Yet, officially, nothing seems to tie
Indeed, in the past two years only the
development have been considered; Algeria's
electronuclear potential dates back only to 31 December
of the FLN central committee. But, according
nuclear power is seen only as a replacement energy
now consuming 4,700 million kWh, and experts agree that
could be built within the next 10 years. We are
between the USSR, France, the United States,
Britain, Italy, Belgium and Brazil. However, France,
Franco-American Atomic Construction Company,
getting the contract, as it offers to transfer the
unacceptable full impunity as it did not sign the non-proliferation
though many international pressure were exerted on Algiers
to sign the treaty, it has not done so yet, but it
argued that after it is promised delivery by nuclear
states' leaders doubt Algiers determination to
of building nuclear power. Indeed, we should take
determination to acquire the full fuel cycle, which
military nuclear proliferation. Algerian officials
rush things when international opinion is watching
building structures in their country for over 24 years,
that so long and that it might take them another

In the land of the Pharaohs, the tradition of centralized
administration. It was continued in modern times, from
Nasser and Sadat.

administrative structures are not excessively modern,
as we might. This was demonstrated by the
assassination. The head of state is also the supreme
of the armed forces. The stability of these structures was also demonstrated
when Anwar el Sadat was assassinated and Hosni Mubarak succeeded him without difficulty.

Education has also been a long tradition in Egypt, which
has, having on its soil the illustrious al-Azhar university
and religious education, the country--which has
has undertaken a large effort of scientific education,
from foreign western universities and sending many of

petrols to foreign institutions. As far as nuclear power is concerned, on February 1981 Egypt announced the implementation of one of the largest nuclear programs in the Third World, involving the acquisition of 8 nuclear power plants with capacities of 900 to 1,000 W; Egypt then sent technicians from the Egyptian electric power company to be trained in the United States, at the IAEA and in France.

The financial wealth of Egypt cannot be denied; it may have needed foreign aids to sustain its formidable war effort, but at any rate it was able to sustain it. In 1970, defense expenditures amounted to 1,262 million dollars, i.e. 19.6 percent of the gross national product, which amounted to 5.2 billion dollars; in 1974, 4,071 million dollars, i.e. 22.8 percent of the gross national product, which amounted to 8.39 billion dollars; in 1979, 2.17 billion dollars, i.e. 11.6 percent of the gross national product, which amounted to 18.6 billion dollars. Indeed, its oil receipts enable Egypt to finance this project. The government has already announced that oil export receipts would contribute up to 500 million dollars per year to finance the project.

The unrelenting future-development condition is not openly fulfilled in this case, as Egypt stated it would devote its efforts only to the peaceful use of nuclear energy, ratified the non-proliferation treaty and the IAEA guarantee agreements and expressed its desire to see 40 percent of its energy needs covered by nuclear electric power by the year 2000. Besides, as far as fuel possession is concerned, the United States, through the Westinghouse Company, have promised to sell Egypt the little-enriched nuclear fuel it will require for its power plants during the next 30 years.

On the other hand, the Egyptians say they have discovered seven uranium mines in the Sinai and five in the western desert area. They mentioned reserves of 128,000 tons, an inflated figure according to some experts.

There will be no lack of testing grounds for any future military nuclear development, as the desert covers 96.6 percent of Egypt.

Credible results already reached a first stage when Egypt managed to launch its program against all odds.

When it comes to the enemy and foreign policy, the situation is clear: on the one hand, Israel; on the other hand, the integrist world of Islam. With respect to Jerusalem, Cairo wishes to avoid going to extremes and it says its nuclear energy will be devoted exclusively to peaceful uses, but it knows that Israel possesses 200 atomic bombs ready to be used. Anyhow, the Egyptians have taken the trouble of giving themselves a peaceful image so they cannot be suspected of using atomic energy for military purposes. For instance, at the United Nations, Egypt proposed the creation of a nuclear-free zone in the Middle East; then, on 26 February 1981, Cairo ratified the non-proliferation treaty which it had signed earlier under the condition that Israel would also ratify it--the IAEA guarantee agreements had been signed in June.

Nevertheless, the Egyptians and the British are now negotiating the sale of two graphite-gas and enriched uranium power plant that could easily be diverted to military ends. Is Egypt planning to use nuclear dissuasion to prevent any direct military conflict with Israel?

Libya

We must not mention the oligarchic tradition that is characteristic of Libya, which became a sovereign kingdom on 24 December 1951, and where Idriss I reigned until the coup of the young free officers on 31 August 1969. For over 13 years, Col Mu'ammar al-Qadhdhafi has governed his country to which he has given again a very warlike pan-Islamic orthodox direction. He is at the head of the army and at the head of the administrative and political power. Unfortunately for Libya, its population does not count many physicists, engineers and technicians; rather, it is trained in literary and theological speculations.

Financially, as its oil revenues are high compared to its population, Libya is credible when it says it will acquire a military nuclear potential. In 1970, Tripoli had a gross national product of 28,221.9 million dollars, 0.29 percent of which, i.e. 84 million dollars, were devoted to defense expenditures. In 1975, the Libyan gross national product had dropped to 13.51 billion dollars. However, 203 million dollars were devoted to defense expenditures, which therefore used up 1.5 percent of the gross national product; in 1979, the latter rose to 23.39 billion dollars, of which 448 million dollars, i.e. 1.9 percent of the gross national product, were spent on defense. In 10 years, despite the large variations of its gross national product, Libya multiplied its defense expenditures by a factor of more than 5! This shows what political determination is moving Tripoli... However, before discussing this, let us consider what technological capability Libya can muster to acquire nuclear weapons.

Undeniably, this is one of Libya's weakest points. Despite the creation of an Atomic Energy Commission in 1973, Colonel Qadhdhafi had no choice but to launch a nuclear cooperation policy in all directions. In 1974, Argentine promised only civilian nuclear technology, while Tripoli was desperately looking for a transfer of military nuclear technology! The USSR was approached as early as 1975. But Moscow is very strict when it comes to proliferation, and it only promised to supply a 10-MW reactor that could produce no more than 1.2 kg of plutonium per year. Thus, the USSR made Tripoli ratify the non-proliferation treaty in 1975 and it made it sign the IAEA guarantee agreements in 1980; a Soviet-Finnish 440-MW power plant was supposed to be supplied. Hardly one year later, in October 1981, the Finns announced their withdrawal from the project, which left the power plant sale hanging... The Soviet plan had been applied. In 1976, France declined the offer. In 1978, India slowed down cooperation as much as it could when it noticed that Libyan trainees were becoming excessively curious about military uses of the atom. In 1972, Pakistan was considering an Islamic bomb. Tripoli then financed part of the Islamabad project, but Saudi Arabia, fearing Qadhdhafi's expansionism, cooled Ali Bhutto's enthusiasm for the colonel by offering 800 million dollars to finance Bhutto's project, on the condition that he would stop all cooperation with Libya. Islamabad accepted, knowing that Riyadh would help it in Washington to ensure satisfactory progress of the project. Although Libya has sent 300 technicians to the USSR and 200 in Europe to be trained in the nuclear field, it will probably take a very long time before the Libyans discover the secret of the bomb.

The condition of possessing uranium ore is fulfilled to a certain extent in this case. On the one hand, the Koweiti newspaper AL-RA'Y AL-'AMM announced in March

1979 that large uranium deposits had been discovered in Libya. The newspaper indicated that the technicians in charge of prospection expected to discover further rare-metal deposits in northern Africa. But we do not know whether these deposits are already mined. Another source of supply was acquired through the intervention in Chad in 1979. Finally, Mr Pecquer, general director of the French Atomic Energy Commission, announced in January 1981 that Libya had purchased 400 tons of uranium from Niger during the past few years. During the first half of 1981, it purchased 1,212 tons of uranium ore. In addition, Tripoli appears to be financing pro-Qadhdhafi groups in Gabon, in the Central African Republic and in Niger, a country whose underground contains deposits of the precious ore.

As for testing grounds, there is no lack of them: 93 percent of Libya is covered by the desert.

But what credible results does Libya have to show? For the time being, none, as it has not yet begun its horizontal proliferation.

As for the enemy, it is easier to define. Colonel Qadhdhafi intends to wage war against all states unfaithful to the Islamic dogma as he understands it, for instance its immediate neighbors, Egypt and Tunisia. We have already mentioned the Colonel's pan-Islamism, and he is ready to use any means, for instance an alliance or a treaty, to modify the situation at will. His motivation is strong; but his capacity is small. Yet, as Libya keeps increasing the level of its scientific personnel, it is not impossible that it should one day gain access to the great secret and get involved in vertical nuclear proliferation. What will the great powers do when they feel that day is near?

Morocco

This country, too, follows the Islamic tradition of centralized power, through King Hassan II since the death of his father on 26 February 1961. But the French and U.S. influence on its administration has made a great contribution to its efficiency and its development, which has certainly helped Morocco face the transformation of international relations, the power drift which has been taking place since 1945. A country with an old university tradition, Morocco, too, has had to adapt its school system to the demands of our century and to make up for its deficiencies, especially by sending young students to be trained in France and in the United States. In this perspective of modernism, and as early as 1978, Morocco showed a desire to replace its present sources of energy--oil and gas--in the medium term. Indeed, an agreement was signed in Rabat on 11 June 1978 with the U.S. company General Atomic of San Diego; under this agreement, Morocco was to buy a small nuclear research reactor to equip the Atomic Studies Institute of the Rabat University; it was to start operating in 1978 to make possible various research and to train technicians who would then operate the Moroccan thermonuclear station to be built in 1990. Therefore, scientific personnel training was to be ensured starting with the present generation.

The financial wealth position of Rabat is not quite ideal; military nuclear proliferation requiring the amounts mentioned above cannot be contemplated unless profound economic changes take place! Indeed, in 1970, Morocco's gross national product amounted to 2,859.5 million dollars, of which 84 million dollars, i.e.

[illegible], were devoted to defense expenditures. In 197[illegible], the gross national product had increased to [illegible] billion, 2.3 percent, or 224 million dollars, were devoted to these expenditures. In 1979, these expenditures had increased to 917 million dollars, representing 6.5% percent of the gross national product which then amounted to 14.46 billion dollars--the gross national product had been multiplied by [illegible] in 10 years, whereas defense expenditures had nearly doubled during the same period, especially because [illegible] with Algeria. In 1982, Rabat devoted [illegible] to defense, i.e. 11.5 percent of its 11,453 billion dollars of its gross national product. By devoting a large part of its resources to these expenditures, Morocco, a poor country, therefore demonstrated its firm resolution to join the worldwide technological race leading to nuclear proliferation. It showed its determination to favor future development at the expense of its present.

The problem of uranium ore resources is a crucial one, and the war in the former Spanish Sahara, which possesses phosphate deposits from which uranium can be extracted, is the major cause for Morocco's attachment to this region. Also, the huge open phosphate mine pits could make it possible to dispense with the digging of 1,500-m deep pits to be used for experimental nuclear explosions (which are prohibited in the atmospheric, extra-atmospheric and submarine spaces). It is still too early to assess result credibility.

On the other hand, the enemy is easy to find: it is Algeria, which is about to become a nuclear power, and with which Morocco is fighting over vital interests in the former Spanish Sahara. Although Morocco has signed the non-proliferation treaty in 1970 and the IAEA guarantee agreements in 1975, and although it has a seat on the UN Disarmament Committee, once its exhaustive civilian nuclear research program is completed, it might well engage into military nuclear research if Algeria did, as the two Maghreb countries are threatening each other's vital interests. But Morocco has already outlined its electronuclear program for the period 1993-2002, which provides that four 6,000-MW units will be placed into service, at the rate of one every other year; the first unit could become operational around 1993. Nuclear energy would then be expected to cover approximately 46 percent of the country's electricity needs by the year 2000. As for the nuclear fuel cycle, Morocco attaches special importance to research and to uranium recovery, either from mining deposits or during the production of phosphoric acid from phosphates, as the country's underground already contains these resources.

Tunisia

We cannot dream of more continuity and more stability for Tunisia, which President Bourguiba has been ruling since 25 July 1957. The state is centralized and decisions are made systematically at the top of the political and administrative hierarchy whose echelons are relatively even and transmit smoothly all the decisions, whether civilian or military. Since its independence, Tunisia has undertaken a considerable task of education and it now possesses many university graduates in scientific disciplines.

In 1970, its gross national product was 1,313.7 million dollars, of which 18 million, i.e. 1.5 percent, were spent for defense; in 1975, this figure rose to 43 million, i.e. 1.05 percent of the gross national product amounting to 4.09 bil-

lion dollars. In 1979, the Tunisian gross national product was estimated at 6.95 billion dollars, and 2 percent of that amount were devoted to defense expenditures which were then estimated at 145 million dollars. In 1981, the gross national product was 7.42 billion dollars; 1.5 percent, or 118 million dollars, were devoted to defense expenditures.

In this respect, a nuclear program would place a very heavy burden on Tunisia.

We mentioned previously that several mining exploration offices thought they might discover uranium-containing deposits in North Africa; this could help Tunisia which otherwise would have to buy on the international market. For its nuclear experiments, this country could perhaps use the strip of desert it owns.

As far as its program is concerned, the Tunisian government, speaking through the Tunisian Electric and Gas Company (STEG), stated in 1982 that the implementation of a preliminary study concerning the preparation of a nuclear program was postponed "for at least two years." As a result, the first Tunisian electronuclear power plant would become operational only in the 2000's.

The official reasons for this postponement have to do especially with the small size of the local market, the high cost of construction and the difficulties encountered in selecting a site. The minimum size of a nuclear power plant is 600 MW; such a power plant would increase by 50 percent the country's electric production capacity. However, the STEG is also said to be waiting for the development of mini-power plants of 300 MW.

Tunisia is therefore contemplating a civilian program first, and it will probably be unable to afford military nuclear proliferation, although it has a restless neighbor, Libya under Colonel Qadhdhafi, who has already attacked it once! Will Tunisia become a French base?

9294
CSO: 5100/4600

SEMINAR DISCUSSES NUCLEAR SAFETY

London AL-SHARQ AL-AWSAT in Arabic 24 Nov 83 p 7

[Article: "Nuclear Safety Seminar in Cairo Begins; 8 Nuclear Power Stations in Egypt in the Year 2005 and an Agreement To Purchase Natural Uranium from Niger"]

[Text] A seminar on nuclear safety and standards for selecting sites for nuclear power plants began in the Egyptian capital 2 days ago. The seminar is to continue until today.

The seminar, which is being attended by a number of nuclear power experts in Egypt, in the world and in the International Commission on Atomic Power, is discussing standards for selecting and determining ideal sites for power stations. Experts attending the seminar will discuss the geological factors of soil components, soil movement, ground water, the tendencies of earthquake zones, oceanography, considerations of nuclear safety and [measures for] protecting the vital environment around a [nuclear] power station. This includes man, plants, aquatic life, animal life and the soil. These measures include protecting the environment from the dangers of nuclear contamination.

Experts will especially look into considerations of safety and nuclear security at the location of al-Dab'ah nuclear power plant.

Engineer Muhammad Mahir Abazah, minister of power and energy, announced that Egypt would go ahead and implement the Egyptian national program for nuclear power plants despite the warnings that were issued by the U.S. Export and Import Bank. The bank had warned that the Egyptian economy was not strong enough to finance Egypt's national nuclear power program.

Engineer Abazah said, "Quite contrary to the warning, the whole world has confidence in the Egyptian economy. We have about 700 million dollars deposited in the Egyptian Central Bank. These funds, returns from [our] oil exports, are earmarked for financing the program. These funds will be increased over the coming years."

Engineer Abazah added, "The confidence of the world will be confirmed next Saturday, God willing, when the envelopes containing bids for supplying and building the first nuclear power plant in al-Dab'ah will be unsealed. That power plant will have two reactors, each with a capacity of about 1,000 megawatts."

[illegible]

[illegible] NUCLEAR WEAPONS PROLIFERATE VERTICALLY

[illegible] The Hindu in English 10 Nov 83 p 6

[illegible]

NEW DELHI Nov 9

The controversy over whether weapon grade plutonium could be obtained from civilian nuclear reactors often masked the vertical proliferation of nuclear weapons and technology taking place in the nuclear weapon states today.

According to Dr Bhupendra Jasani research fellow at the Stockholm International Peace Research Institute (SIPRI) it was well known that the basic knowledge and infrastructure required for a nuclear weapons programme could be obtained from the civilian nuclear industry. But making use of the fissile material for manufacturing a usable nuclear weapon has proven to be beyond the capabilities of conventional nuclear technologies. Dr Jasani said in a talk delivered here on Tuesday.

A study of the location and distribution of nuclear facilities around the world had shown that most installations were either in nuclear weapon states or were under international safeguards in other countries. The danger from the horizontal proliferation of nuclear technology was nothing compared to the risks involved in the highly classified military research which was going on in nuclear weapon states, he said. The disposal of nuclear waste, 80 per cent of which was generated by weapon fuel cycles, constituted a far greater danger than the safety problems encountered in the operation of nuclear power reactors.

Dr Jasani said the trend in third generation nuclear weapons was towards miniaturisation and reducing the size-to-yield ratios. The new technologies on the horizon enabled the production of weapons tailored to specific requirements. The neutron bomb, for instance, enhanced radiation to extinguish life but reduced the blast and heat factors to cause maximum damage to property.

New technology. One of the new technologies, still in the formative stage but which has already contributed to the design of nuclear blast proof satellites, was the inertial confinement fusion (ICF) technology. So far the study of the effects of a nuclear explosion was limited to underground nuclear tests. The monitoring of a blast at very close range and the study of the electro-magnetic pulse (EMP) effect accompanying an explosion was impossible in an underground test.

But the study of micro-explosions created by the fusion of hydrogen atoms under laboratory conditions as in ICF provided valuable data. The "hardening" of the protective layer of military satellites making them resistant to the EMP effect was a direct fallout of ICF technology, Dr Jasani said.

Another frontier technology related to the vertical proliferation of nuclear weapons was the work going on in developing high-breed reactors. This complex system involved the use of both the fission and fusion processes to produce weapons-grade material.

Ironically, nuclear weapon states were also developing methods to salvage plutonium 239 from civilian nuclear reactors, a charge often made against countries with peaceful nuclear programmes.

Dr Jasani said since very little was known about these new technologies because of the secrecy shrouding military research, the SIPRI was trying to put together information to reveal the dangers of qualitative and quantitative advances in nuclear weapon technology.

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UTILITY OF NUCLEAR POWER STATIONS QUESTIONED

Johannesburg MINING WEEK in English 7 Dec 84 pp 1, 3

[Article by Madden Cole]

[Text] Nuclear power stations were obsolete, expensive, dangerous and unreliable and were important contributors to inflation, Dr Ehud Finkelstein of the Chemical Department of Wits University told MINING WEEK.

Commenting on the recent design award to the Koeberg Nuclear Power station, Dr Finkelstein said that it could be compared with awarding a prize to "the most beautiful white elephant in town."

"A good indication of the future prospects of nuclear electricity is the present situation in the United States.

"Here we have a free enterprise economy which has decided against the nuclear option mainly for economic reasons."

Dr Finkelstein said that nuclear energy accounted for only about five percent of the total energy consumption.

"And we find that the inflation rate in the United States is lower than that of France, for example, where about 30 percent of the electricity is generated by nuclear power.

"What is significant is the fact that nuclear energy is adopted and promoted mainly in the more socialistic countries such as France--and of course Russia--for other than purely economic reasons.

"And in such countries where the government is heavily involved in the economy, competition is absent and the state can recoup its extra costs from the taxpayer."

According to Dr Finkelstein it has been discovered in the United States that "nuclear electricity" costs twice as much as "conventional electricity".

In the last few years the number of orders of nuclear power stations dwindled from 10 to 20 a year to zero, and construction of power stations

had stopped after billions of dollars had been invested in design, site preparation, building and equipment.

"In addition, reliability studies showed that nuclear reactors were completely unreliable."

Dr Finkelstein cited the example of the Browns Ferry twin reactors of the Tennessee Valley Authority which almost melted down and the reactor in southern New Jersey which failed twice in two days to shut down automatically when conditions deviated from normal.

Referring to the situation in SA, Dr Finkelstein said that it was ridiculous that the country exported coal to countries which preferred "conventional electricity" while SA was gearing itself for "nuclear electricity".

Dr Finkelstein agrees that once the fusion process has been perfected, nuclear energy will become a viable proposition.

"But this technology is not at hand at present and it could take another 50 to 100 years to perfect.

"Besides, the world's coal reserves and as a consequence, liquid fuel such as methanol are sufficient to last up to another 300 years."

For these reasons Dr Finkelstein feels that there is no reason to panic about future energy resources.

"This means that we can bypass the present nuclear technology as we have all the time in the world to develop the fusion process.

"So it is stupid to start worrying now about solving energy problems which are only likely to affect us in a few centuries' time."

Pollution problems caused by coal-fired power stations did not present insurmountable problems nor would the cost of a "clean air" policy be prohibitive, Dr Finkelstein said.

"The added costs of such a policy could largely be recouped by the sale of sulphuric acid, a by-product of sulphur dioxide. So the price of electricity need not rise exorbitantly."

Dr Finkelstein said that the main reason why nuclear energy was being promoted was because of vested interests.

"People involved in nuclear physics are naturally keen to see advances made in their field, but their attempts to promote this option is a futile exercise--like trying to save a sinking ship," Dr Finkelstein said.

CSO: 5100/12

...ANCE FAST BREEDER REACTOR

...erman 14 Nov 83 p 9

...s and The Hague Still in Difficulties Over the Fast

...esitation, both the Dutch and Belgian ... now slightly increased their contribution ... the SNR 300 ...ast ...reeder in Kalkar. Both ... contribute 15 percent of total costs but have now ... share to DM 510 million.

...nomic Affairs van Aardenne of the rightwing liberal ...ision to raise the financing ceiling on the argument ... not possible, the government in Brussels had more ... the Martens government had to give an ultimatum ... involved (90 percent of the Belgian contribution is ... the remaining 10 percent comes from private firms, ... companies) to make them accept paying their pro- ... Martens even confronted the private parties with ... increasing their contribution, or risking total ... rights to recourse.

... held between the Federal Ministry for Economics and ... and energy ministers van Aardenne (Netherlands) and ... raising the contributions because of constantly rising ... The Netherlands finally agreed to a contribution ... million, but only on condition that the Belgian ... positively on it; the Belgian Government thus came under ... This year's budgets in Brussels and The Hague still ... of DM 470 million; the additional DM 40 million are ... year's budgets, and, therefore, must be approved by the

... face criticism by opposition deputies in the House ... he was accused of having misinformed parliament be- ... late October stated that the Dutch share was limited ... reference was made to the impending raise. During the

debate, van Aardenne pointed out that this new ceiling was fixed until 1987, the year when the SNR 300 would become operative.

Incidentally, the Dutch Government made an about face in agreeing to the share increase, since the government declaration of the economy-drive year 1981 had expressed the intent to withdraw from the Kalkar project; however, this decision was made by the coalition then in power under van Agt, the Christian Democratic predecessor of present Prime Minister Lubbers, under pressure of the then coalition partners Workers' Party/PvdA and Democrats '66. The present coalition of Christian Democrats and Liberals, on the other hand, is not bound by an antinuclear power policy.

9917
CSO: 5100/2525

... 1984, in comparison to the target amount for 1983 and to the ... result in 1982.

... ATOMWIRTSCHAFT/ATOMTECHNIK 11/82, p 590

(1) Wichtige Einzelausgaben in Mio DM zur Förderung der Gebiete	(2) 1983 (Soll)	1982 (Soll)	(3) 1981 (Ist)
4. Förderung der Reaktorentwicklung	756.30	771.80	1037.60
(5) Gesamtkosten			
THTR 300	4 000.00		
HTR Weiterentwicklung	1 772.80		
SNR 300	6 936.70		
SNR Weiterentwicklung	451.80		
SNR Sicherheitskonzept	26.50		
Forschungsreaktor, niedrig angereichert	30.00		
Von dieser Gesamtsumme trägt der Bund 1984	13 219.80		
	756.30		
Reaktorsicherheit und allgemeine nukleare Sicherheitstechnik	119.00	122.00	134.12
Urananreicherung F&E	35.00	37.00	40.17
Urananreicherung Investitionen	67.00	62.00	46.00
Brennelemententwicklung Entsorgung F+E	77.00	72.70	62.73
Brennelemententwicklung Entsorgung Investitionen	161.50	159.50	70.73
Kernphysikalische Grundlagenforschung Forschungsvorhaben	56.00	55.00	51.94
Kernphysikalische Grundlagenforschung Investitionen	30.50	30.50	28.50
Nichtnukleare Energieforschung	586.40	613.50	660.12
Betriebskostenanteil Kernforschungszentrum Karlsruhe GmbH (KfK)	325.35	359.91	340.93
Betriebskostenanteil Kernforschungsanlage Jülich GmbH (KFA)	304.35	294.45	277.84
Betriebskostenanteil Max-Planck-Institut für Plasmaphysik, Garching (IPP)	54.38	53.58	50.73
Betriebskostenanteil GKSS-Forschungszentrum Geesthacht GmbH	62.96	60.12	53.04
Betriebskostenanteil Deutsches Elektronen-Synchrotron, Hamburg (DESY)	91.24	92.84	84.79
Betriebskostenanteil Gesellschaft für Schwerionenforschung mbH, Darmstadt (GSI)	53.10	51.54	47.99
Betriebskostenanteil Hahn-Meitner-Institut für Kernforschung, Berlin GmbH (HMI)	50.99	49.96	46.16

(1) Wichtige Einzelausgaben in Mio DM zur Förderung der Gebiete	(2) 1983 (Soll)	1982 (Soll)	(3) 1981 (Ist)
(26) Betriebskostenanteil Gesellschaft für Strahlen- und Umweltforschung mbH, München (GSF)	84.78	85.10	74.
(27) Investitionen, Kernforschungszentrum Karlsruhe GmbH (KfK)	103.50	99.63	86.
(28) Investitionen, Kernforschungsanlage Jülich GmbH (KFA)	53.55	52.90	46.
(29) Investitionen, Max-Planck-Institut für Plasmaphysik, Garching (IPP)	23.37	22.00	13.
(30) Investitionen, GKSS-Forschungszentrum Geesthacht GmbH	17.40	18.19	18.
(31) Investitionen, Deutsches Elektronen-Synchrotron, Hamburg (DESY)	80.00	40.00	40.
(32) Investitionen, Gesellschaft für Schwerionenforschung mbH, Darmstadt (GSI)	14.60	18.44	18.
Investitionen, Hahn-Meitner-Institut (33) für Kernforschung Berlin GmbH (HMI)	37.17	34.15	25.
(34) Investitionen, Gesellschaft für Strahlen- und Umweltforschung mbH, München (GSF)	17.64	17.45	10.
(35) Max-Planck-Gesellschaft (MPG)	388.72	371.04	361.
(36) Fraunhofer-Gesellschaft (FhG)	108.46	102.77	94.
(37) Beitrag, Institut Max von Laue - Paul Langevin, Grenoble (ILL)	30.38	28.65	23.
(38) Beitrag, Europäische Organisation für Elementarteilchenphysik (CERN)	206.00	197.69	193.
(39) Beitrag, Internationale Atomenergie-Organisation (IAEO)	26.50	22.84	21.
(40) Beitrag, Europäische Gesellschaft für die chemische Aufarbeitung bestrahlter Kernbrennstoffe, Mol (Eurochemic)	12.34	13.23	12.
(41) Zusammenarbeit mit ausländischen Forschungsinstituten	10.00	9.00	10.
(42) Beteiligung am Innovationsrisiko	24.40	13.40	5.
(43) Forschungsplanung	2.22	2.15	2.
(44) Technologietransfer	9.90	9.41	8.
(45) Austausch von Wissenschaftlern mit dem Ausland	10.24	7.50	7.
(46) Auftragsforschung für gewerbliche Wirtschaft	40.00	13.80	13.

1) Letzte Stelle gerundet

Key: 1. Important individual expenditures in millions of DM[1] for support to the various areas
2. (target)
3. (actual)
4. Promotion of reactor development
5. Total costs
6. HTR [high-temperature reactor] further development
7. SNR further development
8. SNR safety plan
9. Research reactors using low-enrichment fuel

[key continued on following page]

9. Of this total, the sum that the Federal Government is covering in 1984
11. Reactor safety and general nuclear safety engineering
12. Uranium enrichment, R & D
13. Uranium enrichment, capital expenditures
14. Fuel-element development, disposal, R & D
15. Fuel-element development, disposal, capital expenditures
16. Basic research in nuclear physics, research projects
17. Basic research in nuclear physics, capital expenditures
18. Non-nuclear energy research
19. Share of operating expenses, Karlsruhe Nuclear Research Center GmbH (KfK)
20. Share of operating expenses, Juelich Nuclear Research Facility (KFA)
21. Share of operating expenses, Max Planck Institute for Plasma Physics, Garching (IPP)
22. Share of operating expenses, GKSS Research Center, Geesthacht GmbH
23. Share of operating expenses, German Electron Synchrotron, Hamburg (DESY)
24. Share of operating expenses, Association for Heavy-ion Research mbH, Darmstadt (GSI)
25. Share of operating expenses, Hahn Meitner Institute for Nuclear Research, Berlin GmbH (HMI)
26. Share of operating expenses, Association for Radiation and Environmental Research mbH, Munich (GSF)
27. Capital expenditures, KfK
28. Capital expenditures, KFA
29. Capital expenditures, IPP
30. Capital expenditures, GKSS Research Center, Geesthacht GmbH
31. Capital expenditures, DESY
32. Capital expenditures, GSI
33. Capital expenditures, HMI
34. Capital expenditures, GSF
35. Max Planck Society (MPG)
36. Fraunhofer Association (FhG)
37. Contribution, Max von Laue-Paul Langevin Institute, Grenoble (ILL)
38. Contribution, European Organization for Elementary Particle Physics (CERN)
39. Contribution, International Atomic Energy Organization (IAEO)
40. Contribution, European Association for the Chemical Processing of Irradiated Nuclear Fuels, Mol (Eurochemic)
41. Cooperation with foreign research institutes
42. Participation in innovation risks
43. Research planning
44. Technology transfer
45. Exchange of scientists with foreign countries
46. Contract research for trade and industry
47. [1] Rounded in last decimal place

12114
CSO: 5100/2529

NUCLEAR ENERGY IN NATION'S PUBLIC ENERGY SUPPLY IN 1982

Duesseldorf: ATOMWIRTSCHAFT/ ATOMTECHNIK in German Nov 83 pp 586-588

[Text] According to the 1982 Annual Statistical Report of the Public Electricity Supply Department in the Federal Ministry of Economics (BMWi), the total gross peak-load capacity of the power plants in the FRG at the end of 1982 came to 90,503 MWe in all, and thus was 1.0 percent more than at the end of the previous year.[1] Of this amount, 74,893 MW came from public power plants, 14,241 MW from power plants in industry, and 1,369 MW from the Federal Railways (Table 1). The share held by nuclear energy was 10,363 MW or 11.5 percent (Table 1 and Figure 1). The share held by nuclear energy in the peak-load capacity of the public power supply was 13.7 percent (Table 2).

In 1982 the total gross generation in the FRG was 366.88 TWh in all. Of this, 303.64 TWh or 82.8 percent came from the public supply, and 57.16 TWh or 15.6 percent from industry's own plants (Table 3 and Figure 2). The nuclear power plants generated 63.58 TWh or 19.7 percent. Of this, 62.46 TWh came from the public supply, with nuclear power plants attaining a share in electricity generation of 20.6 percent in this sector. For the Federal Railways, the share held by nuclear energy was 18.4 percent.

In 1982 the total power requirements in the FRG were about 387.1 TWh and thus were below those of the previous year by 0.9 percent, with 366.9 TWh or 94.8 percent coming from domestic generation and 20.2 TWh or 5.2 percent coming from net imports (Table 4).

The average utilization time of all the power plants was about 4,108 hours in 1982, with brown-coal power plants taking first place with 6,778 h. Nuclear power plants reached 6,123 h. In the preceding year 1981, the utilization time was about 4,197 h as a whole, and that of nuclear power plants was about 5,824 h (Table 5).

Figure 3 shows the changes in power plant capacity from 1960 to the end of 1982. Table 6 shows the changes in electricity consumption, primary-energy

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[1] See "Nuclear Energy in the Power Production Economy of the FRG, 1981," ATOMWIRTSCHAFT 27, p 646 (December 1982).

consumption, and in the gross national product in the FRG from 1972 to 1982 [illegible]. In 1982 the gross electricity consumption declined compared to the previous year by 0.8 percent, the industrial electricity consumption declined by 2.8 percent, and the primary-energy consumption dropped by 3.4 percent, while the gross national product declined by 1.1 percent. The coverage of the power requirements of the FRG in the years 1960 to 1982 is shown in Figure 4.

Table 1: Gross Peak-load Capacity of All Power Plants in the FRG at the End of 1982 (in MW)

(1) Energieträger	(2) öffentliche Kraftwerke MW	(3) Industrie-kraftwerke MW	(4) Bundesbahn-kraftwerke MW	(5) insgesamt MW	(6) Änderung 1981/1982 %
(7) Wasser:					
(8) Laufwasser	2 382	221	146	2 749	+ 1.9
(9) Speicher - Pumpspeicher	3 599	—	193	3 792	+ 0.01
(10) Summe Wasser	5 981	221	339	6 541	+ 0.8
(11) Wärme:					
(12) Kernenergie	10 206	—	157	10 363	± 0,0
(13) Braunkohle	12 978	782	—	13 760	- 0.9
(14) Steinkohle	10 809	4 806	435	16 050	- 1.8
(15) Steinkohlen-Mischfeuerung	11 416	2 687	223	14 326	+ 9.7
(16) Öl	11 190	2 567	—	13 757	- 1.1
(17) Gas	11 668	2 708	215	14 611	- 0.9
(18) Sonstige	625	470	—	1 095	+32.6
(19) Summe Wärme	68 912	14 020	1 030	83 962	+ 1.0
(20) Insgesamt	74 893	14 241	1 369	90 503	+ 1.0
(21) Änderung 1981/82 (%)	+1.8	−3.2	−0.1	+1.0	

(22) (Quelle BMWi)

Key:
1. Source of energy
2. Public power plants
3. Industrial power plants
4. Federal Railways power plants
5. Total
6. Change 1981/1982
7. Water:
8. Flowing water
9. Reservoirs-pumped storage
10. Sum for water
11. Heat:
12. Nuclear energy
13. Brown coal
14. Hard coal
15. Hard coal-multifuel firing
16. Oil
17. Gas
18. Other
19. Sum for heat
20. Total
21. Change 1981/82 (%)
22. (source: BMWi)

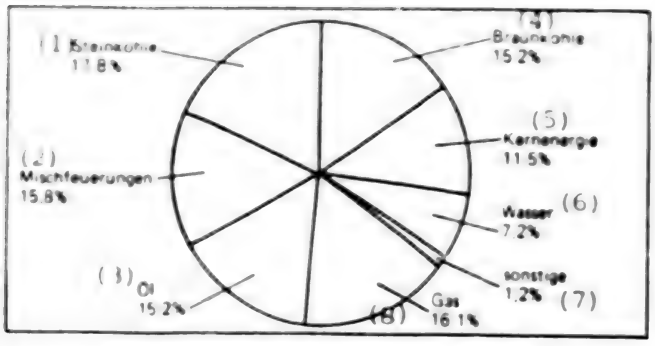

Figure 1: Share Held by the Various Sources of Energy in the Total Peak-load Capacity of Power Plants in the FRG in 1982 (100% = 90,503 MWe) (see Table 1) (source: BMWi)

Key: 1. Hard coal
2. Multifuel firing
3. Oil
4. Brown coal
5. Nuclear energy
6. Water
7. Other
8. Gas

Table 2: Changes in the Public-supply Power Plants in the FRG During 1982

(1) Kraftwerksart	(2) Brutto-Engpaß-leistung MWe	(3) Anteil %	(4) Zubau 1982 MWe	(5) Abgang 1982 MWe	(6) Änderung 1981/82 %
Wasser: (7)					
Laufwasser (8)	2 382	3.2	49	—	+ 2.1
Speicher (9)	1 123	1.5	—	—	± 0.0
Pumpspeicher (10)	2 476	3.3	—	—	± 0.0
Wärme: (11)					
Kernenergie (12)	**10 206**	**13.7**	—	—	**± 0.0**
Braunkohle (13)	12 978	17.4	—	107	- 0.8
Steinkohle (14)	10 809	14.4	1 025	124	+ 9.0
Steinkohlen-Mischfeuerung (15)	11 416	15.2	629	538	+ 0.8
Heizöl (16)	11 190	14.9	253	71	+ 1.7
Erdgas (17) (18)	11 688	15.6	5	177	- 1.4
andere Energiequellen	625	0.8	46	13	+ 9.7
insgesamt (19)	74 893	100.0	2 008	1 030	+ 1.3

(Quelle BMWi) (20) (21) Rundungsdifferenzen

Key: 1. Type of power plant
2. Gross peak-load capacity
3. Share
4. Buildup, 1982
5. Reduction, 1982

[key continued on following page]

6. Change 1981/1982
7. Water:
8. Flowing water
9. Reservoirs
10. Pumped storage
11. Heat:
12. Nuclear energy
13. Brown coal
14. Hard coal
15. Hard coal-multifuel firing
16. Fuel oil
17. Natural gas
18. Other sources of energy
19. Total
20. (source: BMWi)
21. Differences due to rounding

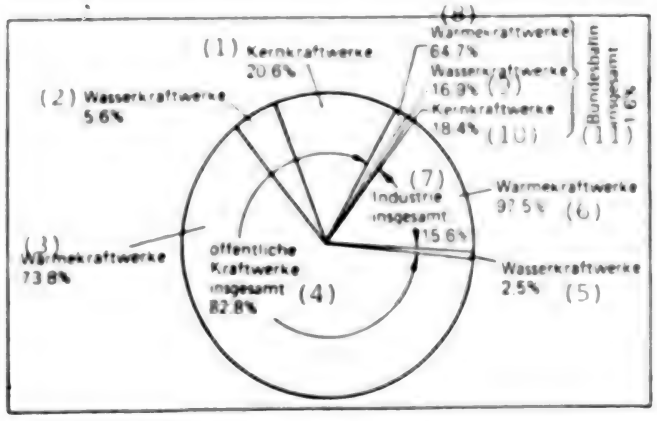

Figure 2: Shares Held by Energy Sources in the Gross Electricity Generation in the FRG During 1982 (100% = 366.88 TWh) (see Table 3). (source: BMWi)

Key:
1. Nuclear power plants
2. Water power plants
3. Thermal power plants
4. Total public power plants
5. Water power plants
6. Thermal power plants
7. Total for industry
8. Thermal power plants
9. Water power plants
10. Nuclear power plants
11. Total for Federal Railways

Table 1: Electricity Generation and Fuel Consumption by all Power Plants in the FRG in 1981 and 1982

(1) Energieträger	(2) Insgesamt			(3) Öffentliche Kraftwerke			(4) Industriekraftwerke			(5) Bundesbahn		
	Erzeugung (6)	Brennstoffeinsatz (7)		Erzeugung	Brennstoffeinsatz		Erzeugung	Brennstoffeinsatz		Erzeugung	Brennstoffeinsatz	
	Mrd. kWh	Mio t	Mio t SKE	GWh	Mio t	Mio t SKE	GWh	Mio t	Mio t SKE	GWh	Mio t	Mio t SKE
1981												
(8) Wasser	24 960	—	8 549	23 828	—	8 162	1 867	—	0 641	1 265	—	0 433
(9) Kernenergie	93 641	—	32 041	92 444	—	31 648	—	—	—	1 197	—	0 393
(10) Braunkohle 1)	127 170	129 958	43 318	121 890	122 571	40 857	4 844	4 799	1 602	—	—	—
(11) Steinkohle (SKE)	117 707	74 121	77 121	94 320	57 897	57 897	20 920	9 435	9 435	2 467	0 499	0 499
(12) sonstige feste Brennstoffe (SKE)	1 455	1	1	1	—	—	1 454	—	—	—	—	—
(13) Heizöl 2)	21 486	3 645	5 832	9 636	1 559	2 527	9 623	1 556	2 176	287	0 066	0 096
(14) Erdgas	47 134	12 242	17 206	7 993	1 946	2 737	35 159	8 640	12 156	983	0 250	0 345
(15) sonstige gasförmige Brennstoffe	9 801	2 852	3 305	2 729	0 738	2 801	5 821	1 974	2 152	451	0 140	0 152
(16) sonstige Brennstoffe	3 566	—	1 769	1 549	—	0 495	2 057	—	0 674	—	—	—
(17) Insgesamt	366 810	—	199 834	361 777	—	99 679	80 711	—	18 010	6 322	—	2 145
1982												
(8) Wasser	19 648	—	6 864	17 172	—	5 650	1 446	—	0 476	1 028	—	0 338
(9) Kernenergie	63 657	—	20 917	62 457	—	20 548	—	—	—	1 120	—	0 369
(10) Braunkohle 1)	93 017	129 544	32 447	88 365	114 698	31 166	4 652	4 693	1 261	—	—	—
(11) Steinkohle (SKE)	122 421	74 102	74 102	91 497	59 135	59 135	27 750	9 089	9 089	2 773	0 878	0 878
(12) sonstige feste Brennstoffe (SKE)	1 803	0 406	0 406	1 803	0 406	0 406	—	—	—	—	—	—
(13) Heizöl 2)	17 241	3 372	4 702	8 663	1 990	2 744	8 507	1 395	1 935	71	0 017	0 023
(14) Erdgas	37 136	9 760	10 596	29 373	7 695	8 660	7 125	1 570	1 704	638	0 195	0 212
(15) sonstige gasförmige Brennstoffe	8 527	2 702	2 933	2 500	0 681	0 739	5 578	1 882	2 043	449	0 139	0 151
(16) sonstige Brennstoffe	4 310	—	1 414	2 214	—	0 728	2 096	—	0 690	—	—	—
(17) Insgesamt	366 877	—	119 985	303 644	—	99 816	57 154	—	17 198	6 079	—	1 971

(18) (Quelle BMWi)

(19) Anmerkungen: m³ umgerechnet auf H_u = 7 000 kcal/m³

Darin enthalten in öffentl. Kraftwerken:
1981 = 3249 GWh aus Hartbraunkohle, Verbrauch 2 199 Mio t
1982 = 2667 GWh aus Hartbraunkohle, Verbrauch 1 837 Mio t
Einschließlich Dieselöl

in Industriekraftwerken:
1981 = 57 GWh aus Hartbraunkohle, Verbrauch 0.035 Mio t
1982 = 22 GWh aus Hartbraunkohle, Verbrauch 0.007 Mio t

(20) Außerdem wurden für Fernwärmeabgabe fossile Brennstoffmengen verbraucht:

(21)		(22) in öffentlichen Kraftwerken		(22) in Kraftwerken der Bundesbahn	
		1981	1982	1981	1982
(23) Braunkohle	Mio t SKE	—	0.13	—	—
(24) Braunkohlenbrikettabsatz	Mio t SKE	—	0.008	—	—
(25) Steinkohle	Mio t SKE	1.886	1.885	0.022	0.039
(26) Heizöl	Mio t	0.515	0.463	0.001	0.006
(27) Erdgas	Mrd m³n	1.065	1.058	0.013	0.011
(28) sonstige Gasarten	Mrd m³n	0.183	0.186	—	—

Key:
1. Source of energy
2. Total
3. Public power plants
4. Industrial power plants
5. Federal Railways
6. Generation
7. Fuel consumption
8. Water
9. Nuclear energy
10. Brown coal[1]
11. Hard coal (hard-coal units)
12. Other solid fuels (hard-coal units)
13. Fuel oil[2]
14. Natural gas
15. Other gaseous fuels
16. Remaining fuels
17. Total
18. (source: BMWi)

(key continued on following page)

17. Natural gas converted to H_o = 7,600 kcal/m^3

18. This includes, in public power plants:
    1981: 3,249 GWh from hard brown coal; consumption 2.199 million tons
    1982: 2,667 GWh from hard brown coal; consumption 1.837 million tons

19. Industrial power plants:
    1981: 47 GWh from hard brown coal; consumption 0.035 million tons
    1982: 10 GWh from hard brown coal; consumption 0.007 million tons

20. Including diesel oil

20. In addition, the following amounts of fuel were consumed for district-heating output:

21. In public power plants

22. In power plants of the Federal Railways

23. Brown coal

24. Brown coal briquette dust

25. Hard coal

26. Fuel oil

27. Natural gas

28. Other types of gas

Table 4: Coverage of the total Power Requirements of the FRG in 1982

	(1) Deckung TWh	(2) Anteil %	(3) Änderung 1981/1982 %
(4) Erzeugung im Inland:			
Öffentliche Kraftwerke	302.6	78.4	+ 0.6
Industriekraftwerke	57.2	14.8	- 5.8
Bundesbahnkraftwerke	6.1	1.6	- 3.2
(7) Summe	366.0	94.8	- 0.5
(8) Einfuhr aus dem Ausland:			
(9) Schweiz	10.6	2.7	- 10.2
(11) Österreich	5.3	1.4	+ 1.9
(12) Frankreich	2.7	0.4	- 15.0
(13) Sonstige	2.6	0.7	- 10.3
(14) Summe	20.2	5.2	- 7.8
(15) Insgesamt	386.1	100.0	- 0.9

(16) (Quelle BMWi)

Key: 1. Coverage
2. Share
3. Change 1981/1982
4. Domestic generation:
5. Public power plants
6. Industrial power plants
7. Federal Railways power plants
8. Sum
9. Imports from other countries:
10. Switzerland
11. Austria
12. France
13. Others
14. Sum
15. Total
16. (source: BMWi)

Table [illegible] Utilization Time of the Power Plants in the FRG from [illegible]

	[illegible] h	[illegible] h	[illegible] h
[illegible] (1)	[illegible]	[illegible]	[illegible]
[illegible] (2)	[illegible]	[illegible]	[illegible]
Kernenergie (3)	4 782	5 824	6 123
Braunkohle (4)	[illegible]	[illegible]	[illegible]
[illegible] (5)	[illegible]	[illegible]	[illegible]
Öl (6)	[illegible]	[illegible]	[illegible]
Gas (7)	[illegible]	[illegible]	[illegible]
[illegible] (8)	[illegible]	[illegible]	[illegible]

[illegible] Abfälle sowie Hartbraunkohle
[illegible] sowie Müllverbrennung

(10) (Quelle BMWi)

Key: 1. Flowing water
2. Water total
3. Nuclear energy
4. Brown coal[1]
5. Hard coal including multifuel firing
6. Oil
7. Gas
8. Total[2]
9. [1]From 1975 on this includes hard brown coal
[2]Including refuse-burning power plants
10. (source: BMWi)

Table [illegible] Changes in the Electricity Supply, the Primary-energy Consumption, and the Gross National Product in the FRG From 1972 to 1982

(1) Jahr	(2) Bruttosozialprodukt[1]		(3) Primärenergieverbrauch		(4) Bruttostromverbrauch		(5) Industrieller Stromverbrauch	
	(6) Mrd DM	(7) Änderung %	(8) Mio t SKE	(7) Änderung %	TWh	(7) Änderung %	TWh	(7) Änderung %
[illegible]	[illegible]	+ 4.1	354.3	+ 4.4	[illegible]	[illegible]	[illegible]	+ 6.1
[illegible]	[illegible]	+ 4.6	378.5	+ 6.8	[illegible]	[illegible]	[illegible]	+ 8.8
[illegible]	[illegible]	+ 0.5	365.9	- 3.3	[illegible]	[illegible]	[illegible]	+ 1.9
[illegible]	[illegible]	- 1.6	347.7	- 5.0	[illegible]	[illegible]	[illegible]	- 8.7
[illegible]	[illegible]	+ 5.6	370.3	+ 6.5	[illegible]	[illegible]	[illegible]	+ 9.2
[illegible]	[illegible]	+ 2.9	372.3	+ 0.5	[illegible]	[illegible]	[illegible]	+ 1.3
[illegible]	[illegible]	+ 3.5	389.0	+ 4.5	[illegible]	[illegible]	[illegible]	+ 3.8
[illegible]	[illegible]	+ 4.0	408.2	+ 4.9	[illegible]	[illegible]	[illegible]	+ 5.0
[illegible]	[illegible]	+ 1.9	390.2	- 4.4	[illegible]	[illegible]	[illegible]	- 1.3
[illegible]	[illegible]	- 0.3	374.1	- 4.1	[illegible]	[illegible]	[illegible]	- 2.2
[illegible]	[illegible]	- 1.1	361.7	- 3.3	[illegible]	[illegible]	[illegible]	- 2.8

[illegible] (9) in Preisen von 1976
[illegible] Vorläufiges Ergebnis

(10) (Quelle BMWi)

Key: 1. Year
2. Gross national product[1]
3. Primary energy consumption
4. Gross electricity consumption
5. Industrial electricity consumption
6. Billions of DM
7. Change in %
8. Millions of tons of hard-coal units
9. [1]In 1976 prices
[2]Preliminary result
10. (source: BMWi)

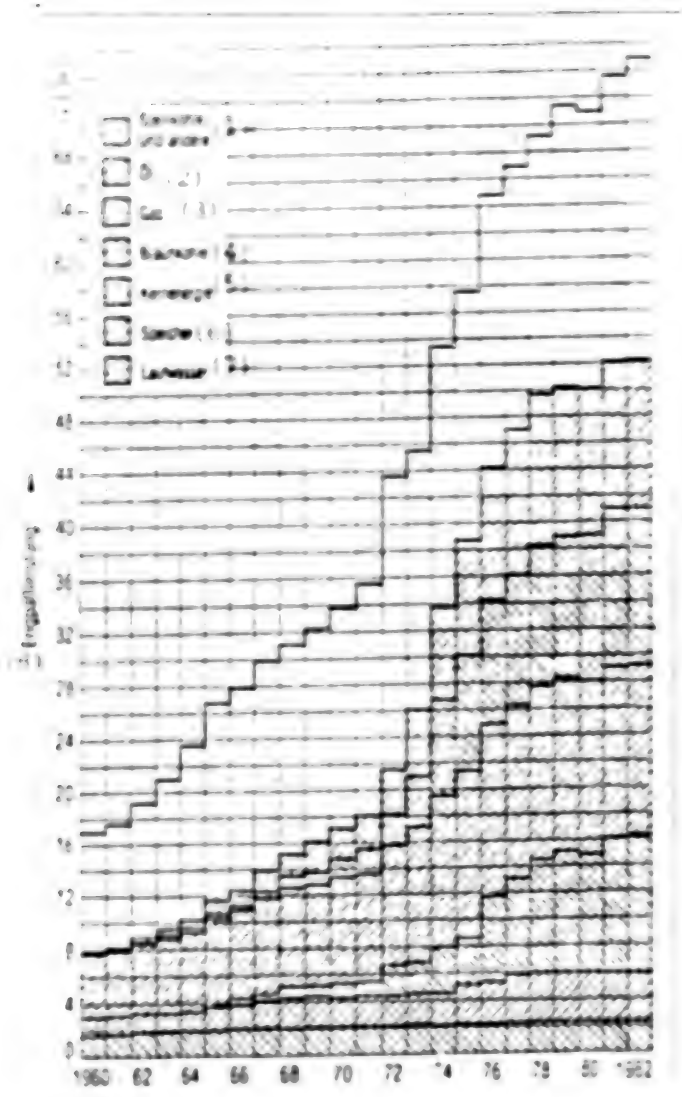

Figure 6: Installed Gross Peak-load Capacity of Public-supply Thermal Power Plants in the FRG From 1960 to 1982 (at year's end in each case) in MW (Source: BMWi)

Key:
1. Hard coal and the like
2. Oil
3. Gas
4. Brown coal
5. Nuclear energy
6. Reservoirs
7. Flowing water
8. Peak-load capacity

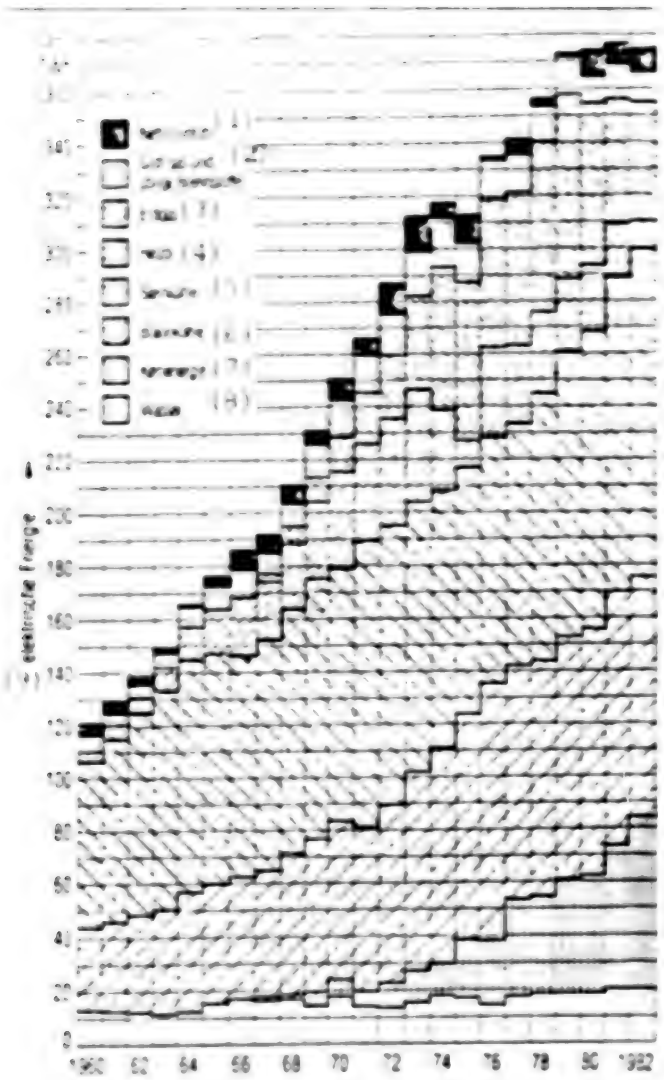

Figure 4: Coverage of the FRG's Power Requirements From 1960 to 1982 From the Gross Generation of the Public-supply Power Plants, Those of Industry, and Those of the Federal Railways, and Also from the Import Surplus, in TWh (source: BMWi)

Key:
1. Net imports
2. Blast-furnace gas and other fuels
3. Natural gas
4. Fuel oil
5. Hard coal
6. Brown coal
7. Nuclear energy
8. Water
9. Electric power

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IMPORT, EXPORT OF NUCLEAR FUEL IN 1982

Duesseldorf ATOMWIRTSCHAFT/ATOMTECHNIK in German Nov 83 pp 590-591

[Text] The 1982 statistics for the imports and exports of nuclear fuels and source materials provided by the Federal Office for Trade and Industry to the federal minister of the interior show on the import side a weight increase of 5.7 percent and on the export side likewise an increase, of 11.4 percent (Table 4). The figures for the previous year[1] referred to for comparison are indicated in parentheses each time in the following text.

Imports

The major imports in terms of quantity are source materials, depleted uranium, natural uranium, and uranium enriched up to 10 percent (Table 1). Only uranium concentrate is included under source materials. Imports of depleted uranium, here from the USSR above all, and imports of natural uranium continued to be down. The imports of source materials, uranium enriched up to 3 percent, and uranium enriched from 3-10 percent have increased considerably. Imports of highly-enriched uranium and plutonium have likewise increased, whereas imports of thorium have declined. A detailed breakdown gives the following results:

(1) Abgereichertes Uran	359 225 kg	(609 224 kg)	= - 41 %
(2) Ausgangsstoffe	1 399 565 kg	(1 097 716 kg)	= + 27.5%
(3) Natururan	518 477 kg	(563 655 kg)	= - 8 %
(4) Angereichertes Uran			
bis 3%	229 661 kg	(133 555 kg)	= + 72 %
3-10%	484 751 kg	(423 090 kg)	= + 14.5%
10-25%	20 kg	(0)	
25-85%	98 kg	(14 kg)	= +314.3%
(5) über 85%	153 kg	(203 kg)	= - 49.5%
Plutonium	425 kg	(204 kg)	= +108.3%
Thorium	992 kg	(2 370 kg)	= - 58.1%

Key: 1. Depleted uranium
2. Source materials
3. Natural uranium
4. Enriched uranium:
5. Up to 3%
6. Over 85%

1) See also ATOMWIRTSCHAFT/ATOMTECHNIK 27, p 597 (November 1982).

Imports of irradiated material are down, amounting to 21 kg (38.9) [illegible] - 61.7 percent.

Exports

Here also the major exports in terms of quantity are source materials, depleted uranium, natural uranium, and uranium enriched up to 10 percent (Table 2). Source materials, uranium enriched up to 3 percent, and uranium enriched 3-10 percent were increasingly exported, whereas depleted uranium, natural uranium, and uranium enriched more than 10 percent were exported to a decreased extent. The detailed breakdown shows the following results:

Angereichertes Uran (1)	230 701 kg	(386 046 kg)	÷ - 37.9%
Ausgangsstoffe (2)	715 722 kg	(596 185 kg)	÷ + 20.0
Natururan (3)	264 [illegible] kg	(384 [illegible] kg)	÷ - 31.1%
Angereichertes Uran (4)			
bis 3% (5)	132 672 kg	(27 579 kg)	÷ +378.1%
3-10%	321 246 kg	(153 161 kg)	÷ +109.7%
10-25%	12 kg	(29 kg)	÷ - 58.6%
25-85%	36 kg	(53 kg)	÷ - 32.1%
über 85% (6)	124 kg	(225 kg)	÷ - 44.9%
Plutonium	0 kg	(90 kg)	÷
Thorium	46 kg	(79 kg)	÷ - 41.8%

Key: 1. Depleted uranium
2. Source materials
3. Natural uranium
4. Enriched uranium
5. Up to 3%
6. Over 85%

Export of irradiated material is increasing greatly, to 295,428 kg ([illegible] kg) ÷ + 57.8 percent (Table 3). The detailed breakdown gives:

Angereichertes Uran (1)			
bis 3% (2)	248 [illegible] kg	([illegible] kg)	÷ + 52.1%
3-10%	47 208 kg	(44 [illegible] kg)	÷ + 6.8%
25-85%	0 kg	(0)	÷
über 85% (3)	32 kg	(71 kg)	÷ - 54.9%

Key: 1. Enriched uranium
2. Up to 3%
3. Over 85%

Table 11: Imports of Nuclear Fuels and Source Materials Into the FRG in [illegible] (in kg)

Versendungsland	abger. Uran	Ausgangsstoffe	Natur-uran	(5) mit U-235 angereichertes Uran bis 3% (6)	über 3 bis 10% (6)	über 10 bis 25% (6)	über 25 bis 85% (6)	über 85%	Pu	Th	(8) Summe
Frankreich	130	176 210	205 602	89 107	87 595	–	–	–	280	955	
Belgien/Luxemburg	15	–	–	–	2 079	–	15	–	46	–	
Niederlande	–	–	12 931	27 789	41 199	–	–	5	–	–	
Großbritannien	2 276	–	3	10 529	54 040	–	–	–	57	13	
Norwegen	9	–	–	–	78	–	–	–	–	–	
Schweden	–	–	–	1 650	–	–	–	–	–	–	
Schweiz	807	–	–	–	–	–	–	–	36	–	
UdSSR	340 750	–	2	36 363	80 280	–	–	–	–	–	
Südafrika	–	522 150	–	–	–	–	–	–	–	–	
USA	10 662	–	1 840	84 222	219 479	20	43	148	–	24	
Kanada	4 737	–	298 886	–	–	–	–	–	–	–	
Katar	19	–	–	–	–	–	–	–	–	–	
Australien	–	600 191	–	–	–	–	–	–	–	–	
sonstige Länder	–	–	–	1	–	–	–	–	–	–	
Summe	359 225	1 300 565	518 477	229 661	484 751	20	58	153	425	992	2 993 327

Key:
1. Exporting country
2. Depleted uranium
3. Source materials
4. Natural uranium
5. Uranium enriched with U-235
6. Up to
7. Over
8. Sum
9. France
10. Belgium/Luxembourg
11. Netherlands
12. Great Britain
13. Norway
14. Sweden
15. Switzerland
16. USSR
17. South Africa
18. United States
19. Canada
20. Qatar
21. Australia
22. Other countries

Table 2: Exports of Nuclear Fuels and Source Materials From the FRG in 1982 (in kg)

Verbraucherland (1)	(2) abger. Uran	(3) Ausgangsstoffe	(5) mit U-235 angereichertes Uran: (4) Natururan	bis 3% (6)	3 bis 10% (6)	10 bis 25% (6)	25 bis 85% (6)	(7) über 85%	Th	(8) Summe
(9) Frankreich	227 200	363 703	—	8 945	95 054	—	—	62	34	
(10) Belgien/Luxemburg	113	—	—	—	37 810	—	—	—	—	
(11) Niederlande	170	—	66 981	62 766	15 791	—	—	2	—	
(12) Italien	4 921	—	—	—	—	—	—	—	—	
(13) Großbritannien	1 017	—	—	—	—	—	28	—	—	
(14) Dänemark	—	—	—	—	—	3	—	15	—	
(15) Schweden	95	—	—	18 675	26 773	—	—	17	—	
(16) Norwegen	—	—	—	—	77	—	—	—	—	
(17) Schweiz	90	—	—	—	36 236	—	4	2	—	
(18) Österreich	10	—	—	—	—	5	4	4	—	
(19) UdSSR	83	—	149 892	—	—	—	—	—	—	
(20) Ägypten	18	—	3	—	—	—	—	—	—	
(21) USA	29	352 019	—	41 686	93 503	4	—	—	—	
(22) Kanada	3 845	—	—	—	—	—	—	—	—	
(23) Brasilien	184	—	—	—	15 980	—	—	—	2	
(24) Argentinien	—	—	48 627	—	—	—	—	—	—	
(25) Indonesien	6	—	87	—	22	—	—	—	—	
(26) Japan	297	—	—	—	—	—	—	—	—	
(27) sonstige Länder	1 625	—	—	—	—	—	—	—	10	
(8) Summe	239 703	715 722	265 590	132 072	321 246	12	36	124	46	1 674 551

Key:
1. Consumer country
2. Depleted uranium
3. Source materials
4. Natural uranium
5. Uranium enriched with U-235
6. Up to
7. Over
8. Sum
9. France
10. Belgium/Luxembourg
11. Netherlands
12. Italy
13. Great Britain
14. Denmark
15. Sweden
16. Norway
17. Switzerland
18. Austria
19. USSR
20. Egypt
21. United States
22. Canada
23. Brazil
24. Argentina
25. Indonesia
26. Japan
27. Other countries

Table 3: Exports of Irradiated Nuclear Fuels and Source Materials From the FRG in 1982 (in kg)

Verbraucherland (1)	(2) mit U-235 angereichertes Uran (3) bis 3%	3 bis 10%	(3) 25 bis 85%	(4) über 85%	(5) Summe
(6) Frankreich	239 077	47 200	—	—	
(7) Belgien/Luxemburg	—	—	—	4	
(8) Niederlande	1	5	—	—	
(9) Großbritannien	9 101	1	—	—	
(10) Schweden	—	2	—	—	
(11) USA	—	—	9	28	
(5) Summe	248 179	47 208	9	32	295 428

Key: 1. Consumer country
2. Uranium enriched with U-235
3. Up to
4. Over
5. Sum
6. France
7. Belgium/Luxembourg
8. Netherlands
9. Great Britain
10. Sweden
11. United States

Table 4: Changes in the Imports and Exports of the FRG With Respect to Irradiated and Unirradiated Nuclear Fuels and Source Materials From 1978 to 1982

Jahr (1)	(2) Einfuhr kg	(3) Ausfuhr kg
1978	1 966 918	576 755
1979	2 961 891	736 722
1980	1 652 555	709 027
1981	2 831 033	1 736 640
1982	2 993 348	1 969 979

Key: 1. Year
2. Imports
3. Exports

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